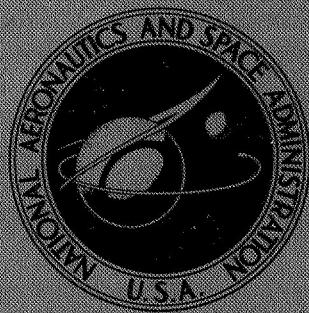


N72-11010

**NASA CONTRACTOR
REPORT**

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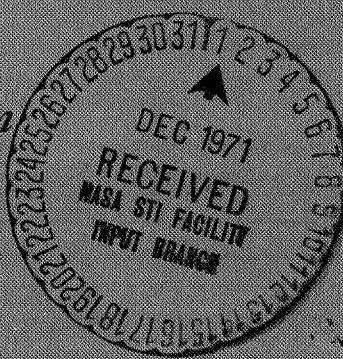
**CASE FILE
COPY**

**MATHEMATICAL MODEL FOR
TWO-DIMENSIONAL MULTI-COMPONENT
AIRFOILS IN VISCOUS FLOW**

by W. A. Stevens, S. H. Goradia, and J. A. Braden

Prepared by
LOCKHEED-GEORGIA COMPANY
Marietta, Ga.
for Langley Research Center

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • JULY 1971



SUPPLEMENT TO NASA CONTRACTOR REPORT CR-1843

**MATHEMATICAL MODEL FOR TWO-DIMENSIONAL
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APPENDIX A

Customer Utilization

Table A-1 defines the various card images used in this program. The formats listed behind the card numbers are both necessary and sufficient, but in many cases the actual formats in the program contain more information. The limit on NXU_i and NXL_i , defined in card 3, is the sum of all the NXU 's and NXL 's, not to exceed 310. The points in cards 5-8 must be input from leading edge to trailing edge for each surface of each component. Furthermore, the order of components must be from leading edge to trailing edge for the total airfoil. Experience with the various boundary layer routines in this program has shown that it is desirable to limit the free stream Mach number by $0 \leq M \leq 0.25$. This limit is not known exactly and can be raised by appropriate modifications to the boundary layer models. The scale factor defined in card 15 multiplies all the input from cards 4-8 and card 17 to convert the input units to feet. The reference chord, defined in the same card, is assumed to be in feet and is used to nondimensionalize the output data as appropriate. Figure A-1 provides sample input data sheets for the computations.

Typical examples of sample output follow Table A-1. The first two pages consist of a listing of the case input in order to identify case output at some future date. This is followed by the non-dimensional geometry. The first copy is the nondimensionalized input and the second is the actual geometry used in computation. This is followed by the slot geometry as defined in Figure VII-2.

The pressure distribution of iteration "0" is the potential flow solution. The turbulent boundary layer summaries for iterations 0, 1, and 2 are only the equivalent airfoil boundary layers while all subsequent computations include a more sensitive calculation for separation prediction. Note that the stagnation pressure is computed based on M_∞ , T_0 and RN/ft .

The "loads summary sheet" presents several interesting features. The component deflections as listed are the actual angles between the free-stream and the true component chord line where angle of attack is positive. The normal and axial force coefficients are normal and tangential to the individual component chords. The component moment coefficients are about the noses of the individual components.

All the force and moment coefficients are based on the reference chord.

TABLE A-1. INPUT FORMATS

- Card 1 Format (8A10)
Title card - may contain any character in columns 1-80
- Card 2 Format (3I5,35X,3A10)
NC - Number of components ($1 \leq NC \leq 4$)
NSP - Number of calculation points ($20NC \leq NSP \leq 165$)
IPLOT - Plot option (should be blank)
= 0 or blank, no plots
= 1 plots
WORDS = Identifier printed on first plot frame
- Card 3 Format (3I5)
NPP - Number of pivot points connected to this component ($0 \leq NPP_i \leq NC-1$)
 NXU_i - Number of upper surface points to be input for this component
 NXL_i - Number of lower surface points to be input for this component
- Card 4 Format (6F10.0)
 $(X_p, Z_p)_i$ - Coordinates of the pivot points referenced to this component in its input coordinate system. If $NPP_i = 0$ skip this card.
- Card 5 Format (8F10.0)
 XU_i - Abscissa of the upper surface input points. NXU values.
- Card 6 Format (8F10.0)
 ZU_i - Ordinate of the upper surface input points. NXU values.
- Card 7 Format (8F10.0)
 XL_i - Abscissa of the lower surface input points. NXL values.
- Card 8 Format (8F10.0)
 ZL_i - Ordinate of the lower surface input points. NXL values.
- *Note: Input cards 3-8 NC times. Component trailing edge must close.
- Card 9 Format (I5)
IM - Index of the main component
- Card 10 Format (4I5, F10.0)
IC - Index of this component
IPP - Index of the pivot point to be used in placing this component
ICR - Index of the reference component
IPPR - Index of the pivot point on the reference component to be used in placing this component
DELTA - Deflection between this coordinate system and the reference coordinate system in degrees
- *Note: This card must be repeated ($NC-1$) times. If $NC = 1$ card 10 is skipped.

TABLE A-1 (CONTINUED)

- Card 11 Format (I5)
 NA - Number of angles-of-attack to be input. ($1 \leq NA \leq 5$)
- Card 12 Format (5F10.0)
 ALPHA - Angle-of-attack, NA values.
- Card 13 Format (I5)
 NM - Number of free-stream Mach numbers. ($1 \leq NM \leq 5$)
- Card 14 Format (5F10.0)
 FSMCH_i - Free-stream Mach number, NM values.
- Card 15 Format (2F10.0)
 CREF - Reference chord in feet. (This number is used to nondimensionalize all of the output)
 SF - Scale factor (This factor multiplies all of the geometry input to convert it to feet)
- Card 16 Format (4F10.0)
 T0 - Stagnation temperature - °R
 RN - Reynolds number - millions/ft.
 PR - Prandtl number
 KF - Heat transfer factor (Use 1.)
- Card 17 Format (I10, 2F10.0)
 LTRAN - Fixed transition option,
 = 0 implies free transition
 = 1 implies fixed transition
 (XTRAN, ZTRAN) - location of fixed transition (Use (0.0) if free transition)
- *Note: Card 17 is repeated 2 NC times. First is upper surface, first component; lower surface, first component; upper surface, second component; etc. If NC = 1 card 18 is skipped.
- Card 18 Format (3I5)
 ISLOT_i - Slot option
 = 0 implies no slot between components (i) and (i+1)
 = 1 implies a slot between components (i) and (i+1)
- Card 19 Format (A10)
 THEbENDbbb - The last data card of last case to be processed. Number of cases which can be run will depend on computer time allowed.

FIGURE A-1

TITLE CARD		
NC	MSP	IPLOT
NPP	NXU	NXL
X _P	Z _P	X _P
X _{U₁}	X _{U₂}	X _{U₂}
Z _{U₁}	Z _{U₂}	Z _{U₂}
X _{L₁}	X _{L₂}	X _{L₃}
Z _{L₁}	Z _{L₂}	Z _{L₃}
IM		
IC	IPR	ICR
		IPPR
		DELTA ₁


```

***** CASE INPUT *****
NC = 2 NSP = 78 IPLOT = -0
NACA 23012 W SLOT , NAS1-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

[ NPP(1) NXU(1) NXL(1)
  1   18      30
XP,ZP = 7.729000E+01 -9.00000E-01
XU = 0. 1.250000E+00 2.500000E+00 5.000000E+00 7.500000E+00 1.000000E+01 1.500000E+01 2.000000E+01 2.500000E+01 3.000000E+01 4.000000E+01 5.000000E+01 6.000000E+01 6.500000E+01 7.000000E+01 7.500000E+01
ZU = 0. 2.670000E+01 3.610000E+00 4.910000E+00 5.800000E+00 6.430000E+00 7.190000E+00 7.500000E+00 7.770000E+00 8.000000E+01 8.270000E+01 8.550000E+01 8.820000E+01 9.080000E+01 9.350000E+01 9.620000E+01 9.890000E+01
XL = 0. 7.600000E+00 7.550000E+00 7.140000E+00 6.410000E+00 5.470000E+00 4.950000E+00 4.360000E+00 3.770000E+00 3.080000E+00 2.730000E+00 2.500000E+00 2.000000E+00 1.500000E+00 1.000000E+00 1.500000E+01 2.000000E+01
ZL = 0. 2.500000E+01 3.000000E+01 3.500000E+01 4.000000E+01 4.500000E+01 5.000000E+01 5.500000E+01 6.000000E+01 6.500000E+01 7.000000E+01 7.500000E+01 7.920000E+01 7.100000E+01 7.200000E+01 7.300000E+01 7.400000E+01
7.457C00E+01 7.632000E+01 7.782000E+01 7.932000E+01 7.932000E+01 8.082000E+01 8.270000E+01 8.462000E+01 8.652000E+01
-4.280000E+00 -4.460000E+00 -4.500000E+00 -4.480000E+00 -4.400000E+00 -4.300000E+00 -4.200000E+00 -4.100000E+00 -4.000000E+00 -3.900000E+00 -3.800000E+00 -3.700000E+00 -3.600000E+00 -3.500000E+00 -3.400000E+00 -3.300000E+00 -3.150000E+00 -2.930000E+00 -2.620000E+00 -2.090000E+00 -1.490000E+00 -4.700000E-01 3.000000E+00
-3.330000E+00 -3.1150000E+00 -2.930000E+00 -2.620000E+00 -2.090000E+00 -1.490000E+00 -4.700000E-01 3.000000E+00
6.700000E-01 1.760000E+00 2.300000E+00 2.650000E+00 2.680000E+00 2.730000E+00
  2   1       16     13
XP,ZP = 0.          13
XU = 0.  -7.900000E-01 4.000000E-01 7.200000E-01 1.360000E+00 2.000000E+00 2.640000E+00 3.920000E+00 5.200000E+00
ZU = 6.480000E+00 7.760000E+00 9.030000E+00 1.031000E+01 1.566000E+01 2.066000E+01 2.300000E+01 2.566000E+01
-1.290000E+00 -3.000000E+00 -4.000000E-02 6.1.000000E-01 1.040000E+00 1.400000E+00 1.940000E+00 2.300000E+00
2.530000E+00 2.630000E+00 2.580000E+00 2.460000E+00 1.680000E+00 9.200000E+00 4.700000E-01 0.
XL = 0. 4.000000E-01 7.200000E-01 1.360000E+00 2.000000E+00 2.640000E+00 2.640000E+00 4.000000E+00 5.660000E+00
ZL = -1.290000E+00 -2.050000E+00 -2.210000E+00 -2.360000E+00 -2.410000E+00 -2.320000E+00 -2.410000E+00 -2.160000E+00
-1.800000E+00 -1.230000E+00 -7.000000E-01 -3.800000E-01 0.

IM = 1
I   IC(1) IPP(1) ICR(1) IPPR(1) DELTA
  1   2      1      1      1      10.000000
NA = 4 ALPHA = 0.        4.000000E+00 8.000000E+00 1.200000E+01
NM = 1 FSNACH = 1.050000E-01
CREF = 3.000000E+00 SF = 3.000000E-02 TO = 5.187000E+02 RN = 1.170000E+00 PR = 7.300000E-01 KF = 1.000000E+00
I   LTRAN XTRAN ZTRAN
  1   UPPER SURFACE 0. 0. 0.

```

0.
0.
0.

0.
0.
0.

0
0
0

LOWER SURFACE
UPPER SURFACE
LOWER SURFACE

2 1
ISLOT =

MAIN COMPONENT

XJ	UPPER SURFACE	ZU	XL	LOWER SURFACE	ZL
0.000000	0.000000		0.000000	0.000000	
.012500	.026700		.012500	.012300	
.025000	.036100		.025000	.017100	
.049100	.049100		.050000	.022600	
.075000	.058000		.075000	.026100	
.111000	.064300		.100000	.0229200	
.150000	.071900		.150000	.035000	
.220000	.075000		.200000	.039700	
.225000	.075000		.250000	.042800	
.330000	.075500		.300000	.044600	
.440000	.071400		.350000	.045000	
.550000	.064100		.400000	.044800	
.660000	.054700		.500000	.044000	
.770000	.049500		.550000	.043000	
.750000	.043600		.600000	.040300	
.880000	.037700		.650000	.035700	
.847000	.030800		.670000	.033300	
	.027300		.680000	.031500	
			.690000	.029300	
			.700000	.026200	
			.710000	.020900	
			.720000	.014900	
			.730000	.004700	
			.740000	.003000	
			.745700	.006700	
			.763200	.017600	
			.773200	.023000	
			.793200	.026500	
			.808200	.026800	
			.827300	.027300	

NACA 23012 W SLOT ,NAS1-9143 CORRELATION CASE 8, a-29-70, 10-DEG FLAP						
X(M.S.)	Z(M.S.)	Xp	Zp	Delta		
.772900	-.009000	*.720000	*.013600	10.000000		
	UPPER SURFACE	ZU	LOWER SURFACE	ZL		
	XJ					
*772032	-.013924	*772032	-.013924			
*777655	-.005066	*774651	-.022103			
*781432	-.002076	*777525	-.024235			
*788724	-.002426	*783567	-.026823			
*795774	-.005549	*789783	-.028427			
*802702	-.007983	*796086	-.029538			
*816245	-.011078	*809635	-.031013			
*829476	-.012401	*826261	-.032320			
*832481	-.012443	*869627	-.036311			
*855260	-.011205	*926357	-.040526			
*867680	-.008508	*976518	-.043989			
*880077	-.005103	1.000118	-.044901			
*931410	-.011869	1.026973	-.045778			
*979331	-.028036					
1.001594	-.036531					
1.026973	-.045778					

MAIN COMPONENT

NACA 23012 W SLOT, NASSI-9143 CORRELATION CASE 8, 9-29-70, 10-DEG FLAP

	XU	UPPER SURFACE	ZU	LOWER SURFACE	ZL
*.013700		.015543		.827000	.027300
*.015791		.029587		.822792	.027136
*.036007		.042423		.810247	.026843
*.063915		.054458		.789639	.025888
*.098992		.064086		.761633	.016804
*.140531		.070866		.727040	.007470
*.187694		.074454		.686030	-.030276
*.239483		.075922		.638966	.036876
*.294832		.075601		.587270	-.041151
*.352606		.073719		.532011	-.043544
*.411616		.070725		.474326	-.044356
*.470670		.066414		.415426	-.044709
*.528538		.061681		.356525	-.045007
*.584054		.056267		.298799	-.044574
*.636066		.051004		.243391	-.042471
*.683528		.045534		.191440	-.039024
*.725453		.040612		.144005	-.034375
*.760989		.036319		.102080	-.029450
*.789430		.032224		.066538	-.024972
*.810161		.029450		.038079	-.020339
*.8422770		.027812		.017242	-.014348
*.8727000		.027300		.004458	-.007421
				-.000000	

NACA 23012 W SLOT ,NAS1-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP						
X(4.0.S.)	Z(M. S.)	Xp	Zp	XL	LOWER SURFACE	ZL
* 772900	-009000	026400	004000			10.00000
XU	UPPER SURFACE	ZU				
.715335	-.007399	1.026973	-.045778			
.703545	-.000647	1.024483	-.045805			
.796309	*005756	1.017145	-.045569			
.813005	*010525	1.005239	-.045106			
.832872	*012520	*89219	-.044471			
.855093	*011232	*969708	-.043608			
.8718664	*005504	*947520	-.042054			
.893000	-.001860	*923452	-.040313			
.927179	-.010484	*898428	-.038451			
.950506	-.018160	*873399	-.036629			
.971978	-.025441	*849376	-.034528			
.990747	-.032235	*822259	-.032404			
1.016102	-.038203	*807836	-.030843			
1.017543	-.042385	*791983	-.028861			
1.024593	-.044922	*780420	-.025663			
1.026973	-.045778	*773544	-.020929			
		*772032	-.013924			

NACA 23012 W SLOT, NAS1-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

SLOT GEOMETRY			PIVOT POINT IS AT X/C = .7729 Z/C = -.0090		
FORE-PIECE IS COMPONENT 1 AFT-PIECE IS COMPONENT 2 REFERENCE COMPONENT IS 1			DEFLECTION BETWEEN SLOT GAP		
FORE-COMPONENT			AFT-COMPONENT		
X/C	Z/C	X/C	X/C	Z/C	G/C
.7525295	.0117762	.7747769	-.0080696	.0298128	
.7574942	.0147035	.7743102	-.0086822	.0288040	
.7624589	.0173726	.7780842	-.0046781	.0270256	
.7674236	.0197572	.7813636	-.0020920	.0259174	
.7723883	.0218253	.7846141	.0010071	.0250101	
.7773530	.0226583	.7877582	.0017736	.0233332	
.7823177	.0241230	.7912609	.0036390	.0223513	
.7872824	.0253775	.7946144	.0050919	.0215700	
.7922471	.0263841	.7980742	.0064036	.0208129	
.7972118	.0270913	.8016266	.0075864	.0199983	
.8021765	.0265055	.8051124	.0087257	.0180206	
.8071412	.0267208	.8087493	.0096427	.0171536	
.8121059	.0269104	.8128156	.0104897	.0164361	
.8170706	.0270607	.8176232	.0112764	.0157940	
.8220353	.0271153	.8224259	.0118573	.0152631	
.8270000	.0273000	.8276723	.0123279	.0149872	

INVISCID FLOW SOLUTION

NACA 23012 W SLOT , NAS1-9143 CORRFLATION CASE 8,9-29-70, 10-DEG FLAP

MACH NUMBER= .10500 ANGLE OF ATTACK= 0.000 0EG.

X	Z	(V/V0)INC.	(V/V0)COMP.	ITERATION NUMBER 0	
				ML	CP
.82700	.02730	1.54130	1.54721	*16271	-1.39451
.82279	.02714	1.52629	1.53195	*16109	-1.34187
.81025	.02684	1.35233	1.35545	*14245	-1.93537
.78964	.02589	1.05829	1.05864	*11117	-1.2068
.76163	.01680	*.80586	*.80509	*15219	*.08450
.72704	-.00747	.70379	.70281	.07375	.56777
.68603	-.03028	1.10619	1.10687	*11625	-.22503
.63397	-.03688	1.01389	1.01397	*10647	-.02814
.58727	-.04115	1.01409	1.01417	*10640	-.02855
.53201	-.04354	1.00703	1.00707	*10574	-.01418
.47433	-.04436	*.98864	*.98858	*10380	*.02272
.41543	-.04471	*.98141	*.98131	*10303	*.03703
.35652	-.04501	*.99060	*.99055	*10401	*.01881
.29880	-.04457	1.00296	1.00298	*10531	-.00596
.24339	-.04247	*.99471	*.99468	*10444	*.01060
.19144	-.03902	*.98038	*.98028	*10292	*.03906
.14401	-.03437	*.94802	*.94776	*09950	*10170
.10208	-.02945	*.91329	*.91287	*09583	*16674
.06654	-.02497	*.89786	*.89738	*09420	*19481
.03818	-.02034	*.88524	*.88470	*09287	*21742
.01724	-.01435	*.78801	*.78718	*08262	*38074
.00446	-.00742	*.51664	*.51559	*05409	*73565
.00000	-.00000	*.20965	*.20910	*.02193	*.95880

INVISCID FLOW SOLUTION

NACA 23012 W SLOT, NASA-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

MACH NUMBER= .10500 ANGLE OF ATTACK= 0.0000 DEG.

X	Z	(V/V0) INC.	(V/V0) COMPRESS.	ML		CP
				UPPER SURFACE COMPONENT NUMBER 1	ITERATION NUMBER 0	
.00370	.01554	1.02911	1.02928	-.05940	-.05940	
.01579	.02959	1.34497	1.34800	.14167	-.81528	
.03601	.04242	1.41501	1.41897	.14916	-.01064	
.06392	.05446	1.47686	1.48173	.15579	-.19158	
.09899	.06409	1.47479	1.47962	.15556	-.18530	
.14053	.07087	1.44964	1.45410	.15287	-.11098	
.18769	.07445	1.38935	1.39295	.14641	-.93788	
.23948	.07592	1.34805	1.35112	.14200	-.82365	
.29483	.07560	1.31464	1.31731	.13843	-.73381	
.35261	.07372	1.28357	1.28588	.13511	-.65231	
.41162	.07073	1.26595	1.26807	.13324	-.60699	
.47067	.06641	1.23564	1.23745	.13001	-.53051	
.52854	.06168	1.22482	1.22653	.12886	-.50367	
.58405	.05627	1.20134	1.20282	.12636	-.44622	
.63607	.05100	1.19871	1.20017	.12608	-.43987	
.68353	.04553	1.18103	1.18232	.12420	-.39746	
.72545	.04061	1.17708	1.17835	.12378	-.38199	
.76099	.03632	1.18330	1.18462	.12444	-.40289	
.78943	.03222	1.14622	1.14722	.12050	-.31585	
.81016	.02945	1.13951	1.14046	.11979	-.30330	
.82277	.02781	1.09414	1.09474	.11497	-.19836	
.82700	.02730	1.10353	1.10287	.11590	-.21765	

INVISCID FLOW SOLUTION

NACA 23012 W SLOT, NASA-9143 CORRELATION CASE 8-9-29-70, 10-DEG FLAP

MACH NUMBER= .10500 ANGLE OF ATTACK= 0.000 DEG.

X	Z	(V/V0) INC.	(V/V0) COMPR.	ML	CP
1.02697	-0.04578	*76405	*76317	*08010	*41805
1.02648	-0.04580	*77127	*77040	*08086	*40693
1.01715	-0.04557	*82940	*82868	*08698	*31356
1.00524	-0.04511	*85562	*85499	*08975	*26920
.98922	-0.04447	*87500	*87443	*09179	*23592
.96971	-0.04361	*89633	*89584	*09404	*19759
.94752	-0.04205	*88086	*88031	*09241	*22519
.92345	-0.04031	*87443	*87386	*09173	*23652
.89843	-0.03845	*86479	*86419	*09071	*25335
.87340	-0.03663	*86374	*86313	*09060	*25519
.84938	-0.03453	*84351	*84283	*08847	*28987
.82726	-0.03240	*81055	*80978	*08499	*34458
.80794	-0.03084	*81931	*81856	*08592	*33026
.79198	-0.02886	*81199	*81122	*08515	*34224
.78342	-0.02566	*71539	*71442	*07497	*49026
.77364	-0.02093	*30709	*30632	*03213	*90843
.77203	-0.01392	*47865	*47763	*05011	*77351

INVISCID FLOW SOLUTION

NACA 23012 W SLOT, NAS1-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP
 MACH NUMBER= .10500 ANGLE OF ATTACK= 0.000 DEG.

X	Z	(V/V0) INC.	(V/V0) COMP.	ML	CP	ITERATION NUMBER 0	COMPONENT NUMBER 2	UPPER SURFACE
.77533	-0.00740	.80948	.80870	.08488	.34633			
.78355	-0.00065	.87097	.87039	.09137	.24259			
.79631	*.00576	*.97052	*.97037	*.10188	*.05840			
.81300	*.01052	1.15867	1.15977	*.12152	-.34475			
.83287	*.01252	1.30233	1.30485	.13712	-.70128			
.85509	*.01123	1.40303	1.40681	*.14788	-.97649			
.87866	*.00550	1.27483	1.27705	*.13418	-.62975			
.90300	-0.00186	1.20857	1.20111	*.12713	*.46378			
.92118	-0.01048	1.09229	1.09288	*.11478	-.14928			
.95051	-0.01816	1.07195	1.07240	*.11262	-.14908			
.97198	*.02544	1.03792	1.03814	*.10901	-.07772			
.99375	*.03223	*.98909	*.98903	*.10385	*.02193			
1.00619	*.03820	*.90321	*.90275	*.09477	*.18514			
1.01754	*.04238	*.85065	*.85000	*.08922	*.27772			
1.02459	*.04492	*.75684	*.75594	*.07934	*.42976			
1.02697	*.04578	*.76405	*.76317	*.08010	*.41805			

LAMINAR BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT , NAS1-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP
 UPPER SURFACE 1
 COMPONENT NUMBER 1
 ILLUSTRATION NUMBER 0

STAGNATION TEMPERATURE	=	518.70	DEGREES RANKINE	*	STAGNATION PRESSURE	=	3322.854	LR/SQ FT
FREESTREAM MACH NUMBER	=	*10500	MILLION	*	AIRFOIL CHORD	=	2.487	FT
REYNOLDS NUMBER PER FOOT	=	1.170000		*	PRANDTL NUMBER	=	*7300	
HEAT TRANSFER FACTOR K	=	1.0000		*	SEPARATION CORRELATION NO.	=	*669619	SQ FT/CFR
SPEED OF SOUND	=	1116.430	FT/SEC	*	KINEMATIC VISCOSITY	=	*00010014	
ANGLE OF ATTACK	=	0.0000	DEGREES	*				
STAGNATION AT X/C	=	*0.00041546		*				
X/C	S/C	M	DM/D(S/C)	H	STAGNATION AT Z/C	=	-0.00205010	
					THETA/C	DELTA/C		CF
*0000000	*003197	.021932	6.776970	2.502335	*000022	*000054		
*003700	*016693	*108081	4.502764	2.510433	*000027	*000067		
*015791	*035651	*141668	1.123387	2.451372	*000036	*000088		
*036007	*059531	*149158	*271304	2.428615	*000054	*000130		
*063915	*089876	*155187	*116348	*421284	*000068	*000165		
*098992	*126272	*155565	-0.032982	2.392048	*000088	*000211		
*140531	*168302	*152868	-0.098156	2.356193	*000111	*000262		
*187694	*215671	*146412	-0.112010	2.314528	*000143	*000332		
N	L	REW	SKIN FR/SQRT(REN)	RENOM	CFAR			
-*106414	*389823	2345.264	*04905351	15.8957	*00017496			
-*106425	*389827	59447.560	*00815000	95.4635	*00073918			
-*047736	*302800	166062.763	*0361493	166.9384	*00099989			
-*025779	*266697	291864.552	*00202501	262.4904	*00094213			
-*017822	*253126	459475.676	*00144957	347.6727	*00082086			
*008489	*203986	644656.567	*00090235	450.0419	*00070355			
*040236	*131258	845203.975	*00046901	558.3866	*00058720			
*076434	0.000000	1038568.990	0.00000000	690.8145	*00047586			
SCRIT/C =	*10424543	RECIT =	385.42	STRAN/C =	*20682005	RTRAN =		
CN LAMINAR SEPARATION HAS OCCURRED AT	X/C =							
SHORT RUBBLE	TRANSITION REYNOLDS NO. =							

CN LAMINAR SEPARATION HAS OCCURRED AT X/C = *178861 S/C = *206820
 SHORT RUBBLE TRANSITION REYNOLDS NO. = 661.900031

TURBULENT BOUNDARY LAYER SUMMARY FOR EQUIVALENT AIRFOIL

NACA 23012 W SLOT, NAS1-9143 CORRELATION CASE E 8,9-29-70, 10-DEG FLAP

UPPER SURFACE
LA/5Q FT
COMPONENT NUMBER
ITERATION NUMBER

STAGNATION TEMPERATURE = 518.70 DEGREES RANKINE
 FREESTREAM MACH NUMBER = .10500 *
 REYNOLDS NUMBER PER FOOT = 1.170000 MILLION *
 HEAT TRANSFER FACTOR K = 1.0000 *
 (INITIAL MOMENTUM THICKNESS) / C = .000024 *
 ANGLE OF ATTACK = 0.0000 DEGREES *

STAGNATION PRESSURE = 3322.854
 AIRFOIL CHORD = 2.482 *
 PRANDTL NUMBER = .7300 *
 TRANSITION POINT, S/C = .20682 *
 INIT. INCOMPRESS. FORM FACTOR = 1.33997 *

X/C	S/C	#	DM / (S/C)	H	THETA/C	DELTA/C	CF
*.178861	*.206820	147444	-.121164	1.339971	*.000236	*.000316	*.000097
*.187694	*.215671	146412	-.112010	1.355344	*.000260	*.000353	*.004360
*.239483	*.267473	141997	-.075184	1.444189	*.000394	*.000569	*.003431
*.294832	*.322816	138430	-.060982	1.464176	*.000534	*.000782	*.004150
*.352606	*.380614	135115	-.044711	1.392505	*.000683	*.000951	*.005798
*.411616	*.439702	133237	-.043155	1.354843	*.000818	*.001109	*.007358
*.470670	*.498883	130009	-.037022	1.341281	*.000986	*.001322	*.003226
*.528538	*.556950	128857	-.032584	1.332486	*.001111	*.001480	*.003175
*.584054	*.612696	126358	-.024451	1.324854	*.001272	*.001686	*.012065
*.636066	*.664981	126079	-.023127	1.319209	*.001366	*.001801	*.013089
*.682528	*.712730	124199	-.037293	1.318807	*.001507	*.001987	*.014451
*.725453	*.754962	122702	-.035454	1.318145	*.001630	*.002149	*.015657
*.760989	*.790767	121432	-.035454	1.317764	*.001739	*.002291	*.016711
*.789430	*.819448	120415	-.035454	1.317577	*.001828	*.002409	*.017577
*.810161	*.840317	119673	-.035454	1.317503	*.001895	*.002496	*.018221
*.822770	*.853093	119222	-.035454	1.317482	*.001936	*.002551	*.018618
*.827000	*.857390	119070	-.035454	1.317477	*.001950	*.002569	*.018753

LAMINAR BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT, NAS1-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

 LOWER SURFACE
 COMPONENT NUMBER
 INTERACTION NUMBER

	X/C	S/C	M	DM/D(S/C)	H	THETA/C	DELTA/C	CF
STAGNATION TEMPERATURE	=	518.70	DEGREES	RANKINE	? 5.536844	.000024	.000060	.004801
FREESTREAM MACH NUMBER	=	.10500			1.350394	.000037	.000090	.003975
REYNOLDS NUMBER PER FOOT	=	1.17000	MILLION		*289249	.000056	.000136	.002477
HEAT TRANSFER FACTOR K	=	1.0000			*092872	.000167	.000083	.001493
SPEED OF SOUND	=	1116.430	FT/SEC		*045855	.000167	.000198	
ANGLE OF ATTACK	=	0.0000	DEGREES		*108470	.004524	.000105	.000253
STAGNATION AT X/C	=	.00041546			*150602	.009503	.000119	.001313
					*198304	.102925	.000132	.001308
					*250374	.104441	.000150	.001163
					*298799	.105313	.000168	.000955
					*363566	.106006	.000186	.000734
					*415426	.103033	.000204	.000460
					*474225	.103798	.000218	.000554
					*532011	.105744	.000230	.000521
					*587270	.106492	.000235	.000562
					*631965	.106470	.000244	.000572
					*6886030	.116251	.000248	.000574
					*692397	-290792	.000171	.001326
						-116251	.000153	.000000

N	L	REW	SKIN FR/SQRT(REW)	REMOM	CFRMR
-1.06414	*389823	13306.980	.01799468	43.3106	.00038958
-0.060055	*322070	60602.831	.00640895	100.3911	.00060430
-0.030387	*274357	135042.023	.00316587	173.2568	.00056423
-0.010417	*239964	227310.152	.00185437	258.3959	.00046799
-0.035559	*263103	34525.663	.0015679	333.1802	.00038858
-0.037510	*286458	497629.589	.00145798	392.2353	.00033932
-0.029950	*273709	677133.224	.00121212	450.8648	.00030597
-0.016933	*251593	867307.270	.00096725	519.2043	.00027808
0.002888	*215032	1068065.805	.00073067	587.4131	.00025250
0.024728	*169489	1254219.345	.00050391	671.3948	.0002822
0.02793	*215218	1444046.670	.00057580	746.1217	.00020824
-0.041487	*292894	1657360.753	.00073689	793.4099	.00019539
-0.0426883	*295140	1890146.211	.00071631	822.3988	.00018702

- .012574	* 243844	2C98572.487	* 00056427	862.5174	* 00017946
- * 106425	* 389837	2281105.924	* 00129231	602.0843	* 00017747
* 226275	0.000000	2666090.906	0.00000000	588.5053	* 00017275
SCRIT/C =	* 24.997692	RECRIT = 517.00	STRAN/C = * 67089775	RTRAN = 592.71	THETAI/C = * 00926242
CN LAMINAR SEPARATION HAS OCCURRED AT X/C = * 664991 S/C = * 670898					
SHORT BUBBLE TRANSITION REYNOLDS NO. = 592.710418					

TURBULENT BOUNDARY LAYER SUMMARY FOR EQUIVALENT AIRFOIL

NACA 23012 W SLOT , NAS1-9143 CORRELATION CASE 8.9-29-79, 13-DEG FLAP

LOWER SURFACE
COMPONENT NUMBER 1
ITERATION NUMBER 0

	STAGNATION TEMPERATURE	=	518.70	DEGREES	RANK INF		STAGNATION PRESSURE	=	3327.854	LB/SQ FT
	FREESTREAM MACH NUMBER	=	*10500		*	AIRFOIL CHORD	=	2.482	FT	
	REYNOLDS NUMBER PER FOOT	=	1.170000	MILLION	*	PRANDTL NUMBER	=	*7300		
	HEAT TRANSFER FACTOR K	=	1.0000		*	TRANSITION POINT, S/C	=	*67090		
	INITIAL MOMENTUM THICKNESS / C	=	*00026		*	INIT. INCOMPRESS. FORM FACTOR	=	1.39056		
ANGLE OF ATTACK		=	0.0000	DEGREES						
X/C	S/C			M	DM/(S/C)	H	THETA/C		DEL S/C	DELTA/C
										CF
*.664991	*.670898		*117467	*180192	1.399563	*.000262	*.000367		*.000441	
*.686030	*.692897		*116251	-290792	1.423261	*.000277	*.000394		*.000410	
*.727040	*.743769		*073753	-250343	2.090569	*.001339	*.002800		*.001073	
*.761633	*.787104		*084500	*628217	1.609947	*.000955	*.001537		*.002399	
*.789639	*.817042		*111172	*588983	1.368987	*.000460	*.000630		*.003050	
*.810247	*.837794		*119052	*170431	1.341943	*.000412	*.000553		*.004169	
*.822792	*.850327		*119604	-082346	1.348158	*.000431	*.000580		*.004074	
*.827000	*.854585		*119070	-168257	1.349781	*.000445	*.000600		*.004033	

LAMINAR BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT, NASA-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

 UPPER SURFACE
 COMPONENT NUMBER 2
 ILLUSTRATION NUMBER 0

STAGNATION TEMPERATURE	=	518.70	DEGREES	RANKINE	:	STAGNATION PRESSURE	=	3322.854	LB/SQ FT
FREESTREAM MACH NUMBER	=	*10500		:	AIRFOIL CHORD	=	*771		FT
REYNOLDS NUMBER PER FOOT	=	1.170000	MILLION	:	PRANDTL NUMBER	=	*7300		
HEAT TRANSFER FACTOR K	=	1.0000		:	SEPARATION CORRELATION NO.	=	*069619		
SPEED OF SOUND	=	1116.430	FT/SEC	:	KINEMATIC VISCOSITY	=	*00010014	SQ FT/SFC	
ANGLE OF ATTACK	=	C.0000	DEGREES	:	STAGNATION AT Z/C	=	-0.01905434		
STAGNATION AT X/C	=	*.77226909		:	THETA/C	DELS/C			
X/C	S/C	H	DM/DS/C	H	THETA/C	DELS/C			
									CF
*.772032	*.003499	*.050108	11.243468	2.503800	.000017	.000042			*.006339
*.775335	*.011047	*.084882	2.942943	2.456214	.000025	.000061			*.006017
*.7833545	*.021610	*.091366	*.665818	2.431836	.000041	.000100			*.003461
*.796309	*.035897	*.101882	*.922990	2.474921	.000049	.000123			*.003870
*.813005	*.053238	*.121823	*.971095	2.478510	.000048	.000120			*.004733
*.832872	*.073231	*.137116	*.631494	2.462458	.000053	.000130			*.004509
N	L	REW	SKIN FR/SQRT(REW)	REMOM	CFBAR				
-106414	*3.89823	5854.665	.02767723	28.1612	.00533512				
-060577	*3.22870	31192.542	.00919348	70.1532	.00879493				
-037900	*2.87074	65620.358	.00456875	125.4867	.00839486				
-075320	*3.45064	121353.352	.00411648	167.3393	.00750933				
-075627	*3.45518	214437.429	.00353500	194.9483	.00742176				
-058564	*3.19780	330948.366	.002666791	238.8773	.00751904				

CONFLUENT BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT, NASA-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

 UPPER SURFACE
 COMPONENT NUMBER 2
 FLOW RATE C

STAGNATION TEMPERATURE	=	518.70	DEGREES RANKINE	*	STAGNATION PRESSURE	=	3322.854	LB/SQ FT
FREESTREAM MACH NUMBER	=	*10500	MILLION	*	SLOT HEIGHT, H/C	=	.01520	
REYNOLDS NUMBER PER FOOT	=	1.170000	DEGREES	*	SLOT EXIT, X/C	=	.82767	
ANGLE OF ATTACK	=	0.00000	,	SPEED OF SOUND	=	1116.430	FT/SEC	
X/C	S/C	M	DM/D(S/C)	H	THETA/C	DELS/C	DELTA/C	
CORE REGION								
*827672	*053238	*147029	*971095	1.881233	*000051	0.000000	0.000000	
*832872	*073231	*137116	*631494	1.746400	*000051	*002361	*036037	
*8555C93	*095520	*147875	-.019927	1.746400	*000073	*001815	*037377	
*878664	*119723	*134183	-.425132	1.746400	*000138	*002215	*039670	
*903003	*14562	*127127	-.380326	1.746400	*000221	*002388	*040136	
*927179	*170897	*114777	-.281880	1.746400	*000348	*002919	*041730	
*950505	*195229	*112621	-.215065	1.746400	*000434	*002812	*043289	
*971978	*217936	*105078	-.332581	1.746400	*000555	*003163	*044743	

MAIN REGION-I

*971978	*217936	*105078	-.332581	1.536782	*000560	*003735	*041138
*990747	*237903	*098438	-.332581	1.602282	*000702	*005041	*044306
1.006102	*256449	*092968	-.332581	1.704361	*000855	*006597	*047660
1.017543	*266537	*088915	-.332581	1.746572	*000992	*008249	*050721
1.024593	*274657	*086420	-.332581	1.746572	*001090	*009496	*052943
1.026973	*276578	*095575	-.332581	1.746572	*001127	*010014	*053795

LAMINAR BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT, NASA-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

LOWER SURFACE
COMPONENT NUMBER 2
ITERATION NUMBER 0

	STAGNATION TEMPERATURE	=	518.70	DEGREES RANKING	*	STAGNATION PRESSURE	=	3322.854	LB/SQ FT
	FREESTREAM MACH NUMBER	=	* 1.0500	MILLION	*	AIRFOIL CHORD	=	.7771	FT
	REYNOLDS NUMBER PER FOOT	=	1.170000			PRANDTL NUMBER	=	* 7300	
	HEAT TRANSFER FACTOR K	=	1.0000			SEPARATION CORRELATION NO.	=	* 069619	
	SPEED OF SOUND	=	1116.430	FT/SEC	*	KINEMATIC VISCOSITY	=	* .00010014	SQ FT/SEC
	ANGLE OF ATTACK	=	0.0000	DEGREES	*	STAGNATION AT Z/C	=	- .01805434	
	STAGNATION AT X/C	=	* .77226909		*	THETA/C	DFLTA/C		
X/C	S/C		M	DM/D(S/C)	H	THETA/C	DFLTA/C		CF
*73644	*0.03202		*032132	8.516694	2.502733	*000019	*000048		*003540
*780420	*0.11778		*074974	3.297065	2.473088	*000026	*000065		*005377
*791983	*0.23829		*085146	*502126	2.422143	*000042	*000102		*003009
*807836	*0.39844		*089197	*005122	*389753	*000153	*000153		*001625
*827259	*0.59819		*084995	*047783	2.402057	*000086	*000207		*001303
*849375	*0.81255		*088469	*123785	2.430710	*000095	*000231		*001453
*873399	*1.05222		*C90603	*047295	2.409327	*00106	*000256		*001178
*898428	*1.30741		*090715	*022483	2.401952	*000122	*000292		*000986
*923452	*1.55d33		*091731	*034199	2.411871	*000132	*000319		*000972
*947500	*1.78d00		*092410	*051676	2.428436	*000142	*000345		*001000
*969708	*2.02244		*094042	*027117	2.368608	*000146	*000346		*000637
*989219	*2.21744		*091791	-.122037	2.2655502	*000166	*000375		*0000000

N	L	REW	SKIN FR/SQRT(REW)	REW/NM	CFBAR
- * 1.06414	* 3.89823	3503.439	*03754287	20.7671	*00297971
- * 0.76787	* 3.47224	29412.046	*01051692	65.9737	*00625222
- * 0.29911	* 2.73700	67492.687	*00456994	119.7098	*00666000
- * 0.0C699	* 2.21943	113805.754	*00242430	182.8519	*00555173
- * 0.11867	* 2.42974	167687.407	*00198584	244.0049	*00453751
- * 0.37232	* 2.85964	239838.270	*00204440	279.3970	*00393282
- * 0.17749	* 2.53027	318178.364	*00158144	319.5419	*00354049
- * 0.11103	* 2.41196	394213.440	*00131253	367.0050	*00320967
- * 0.19900	* 2.56705	475066.932	*00127314	402.7999	*00295741
- * 0.34715	* 2.81623	552625.133	*00129107	435.9696	*00278346
- * 0.19292	* 1.81599	631747.929	*00079401	456.4916	*00262884
- * 1.11679	* 0.00000J	676377.969	0.00000000	505.4687	*00244460

SCRIT/C = * 19541929 KECRIT = 449.03 STRAN/C = .21573778 RTRAN = * 00077028

CN LAMINAR SEPARATION HAS OCCURRED AT X/C = * 983235 S/C = * 215738

TURBULENT REUNIARY LAYER SUMMARY FOR EQUIVALENT AIRFOIL

NACA 23012 W SLOT, NAS1-9143 CORRELATION CASE 8, 9-29-70, 10-DEG FLAP

LOWER SURFACE
COMPONENT NUMBER 2
ITERATION NUMBER 0

	STAGNATION TEMPERATURE	=	518.70	DEGREES RANKINE	STAGNATION PRESSURE	=	3327.854	LB/SQ FT
	FREESTREAM MACH NUMBER	=	*10500	MILLION	AIRFOIL CHORD	=	*.771	
	REYNOLDS NUMBER PER FOOT	=	1.170000		PRANDTL NUMBER	=	*.7300	
	HEAT TRANSFER FACTOR K	=	1.0000		TRANSITION POINT, S/C	=	*21574	
	INITIAL MOMENTUM THICKNESS/C =	=	*.00027		INIT. INCOMPRESS. FORM FACTOR	=	*1.34362	
	ANGLE OF ATTACK	=	0.0000	DEGREES				
X/C	S/C	M	DM/(S/C)	H	THETA/C	DELTA/C	CF	
.983235	*21573d	*092510	-1.17914	1.343617	*000270	*000363	*.000280	
.989219	*221724	*091791	-1.122037	1.361527	*000290	*000395	*.004761	
1.005235	*237751	*089147	-1.154648	1.390844	*000346	*000481	*.004363	
1.017145	*249658	*087666	-1.194904	1.409356	*000397	*000560	*.003295	
1.024483	*256979	*086148	-2.19656	1.421101	*000434	*000617	*.003548	
1.026973	*25953d	*085575	-2.228308	1.424837	*000448	*000639	*.003646	

LOADS SUMMARY SHEET

NACA 23012 W SLOT, NAS1-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

MACH NUMBER	=	"105000
REYNOLDS NUMBER/FT	=	1.170000 MILLION

ANGLE OF ATTACK	=	0.000000
REFERENCE CHORD	=	3.000000

ITERATION NUMBER 6

COMPONENT	1	2
LOCATION OF NUSE		
X=	* 000000	2.316095
Z=	- 000000	-.041772
CHORD=		
COMPONENT DEFLECTION=		
NORMAL FORCES (CM) PRESS.=	* 2.482351	* .770772
	-1.890698	7.122004
AxIAL FORCES		
(CA) PRESS.=	* 570719	* 142083
(CA) SHEAR =		
CA =		
MOMENT ABOUT THE NOSE		
(CM) PRESS.=	* 171086	* 014250
TOTAL LIFT COEFFICIENT=		* 712638
TOT AL. DRAG COEFFICIENT=		* 0000548
TOTAL MOMENT COEFFICIENT=		-.295046
(ABOUT THE POINT (0,0))		

VISCID FLOW SOLUTION

NACA 23012 W SLOT • NAS1-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

MACH NUMBER= .10500

ANGLE OF ATTACK= 0.000 DEG.

LOWFR SURFACE
COMPONENT NUMBER 1
ITERATION NUMBER 4

X	Z	(V/V0) INC.	(V/V0) COMP.	M.	C.P.
.82700	.02730	1.53452	1.54031	.16198	-1.36739
.82279	.02714	1.51965	1.52520	.16038	-1.32138
.81225	.02684	1.34662	1.34967	.14184	-.81975
.78964	.02589	1.05394	1.05427	.11071	-.11145
.76163	.01680	.80261	.80182	.08416	.35743
.72704	-.00747	.72736	.72641	.07623	*.72794
.68603	-.03028	1.14235	1.15332	.12009	-.3n691
.63897	-.03688	1.04503	1.04330	.10977	-.09627
.58727	-.04115	1.04684	1.04711	.10996	-.09642
.53201	-.04354	1.04051	1.04074	.10929	-.08313
.47433	-.04436	1.02227	1.02240	.10736	-.04529
.41543	-.04471	1.01584	1.01593	.10668	-.03212
.35652	-.04501	1.02670	1.02686	.10783	-.05443
.29880	-.04457	1.04169	1.04194	.10941	-.08562
.24339	-.04247	1.03587	1.03609	.10880	-.07346
.19144	-.03902	1.02467	1.02482	.10761	-.05024
.14401	-.03437	.99630	.99628	.12461	.9n743
.10208	-.02945	.96747	.96739	.10156	.06435
.06654	-.02497	.96273	.96253	.10106	.n7754
.03808	-.02034	.96963	.96947	.10179	.n6013
.01724	-.01435	.90395	.90349	.19390	.09485
.00446	-.00742	.69760	.69661	.27310	*.51547
.00000	-.00000	.00481	.00479	.00050	1.0n274

VISCOC FLOW SOLUTION

NACA 23012 W SLOT, NASSI-9143 CORRELATION CASE 8,9-29-70, 10-DEC FLAP
 MACH NUMBER= .10500 ANGLE OF ATTACK= 0.000 DEG.

X	Z	(V/V0)INC.	(V/V0)COMP.	ML	CP
.00370	*01554	*.86988	*.86929	*.09125	*.24449
*.01579	*02959	1.*22435	1.*22605	*.12881	*.50249
*.03601	*04242	1.*32351	1.*32628	*.13938	*.75743
*.06392	*05446	1.*40063	1.*40439	*.14762	*.96970
*.09899	*06409	1.*41034	1.*41423	*.14866	*.99730
*.14053	*07087	1.*39386	1.*39753	*.14689	*.95058
*.18769	*07445	1.*34078	1.*34376	*.14122	*.80389
*.23948	*07592	1.*30396	1.*30650	*.13729	*.70557
*.29483	*07560	1.*27386	1.*27607	*.13408	*.62726
*.35261	*07372	1.*24555	1.*24747	*.13106	*.55532
*.41162	*07073	1.*22952	1.*23127	*.12936	*.51530
*.47067	*06641	1.*20090	1.*20238	*.12631	*.44517
*.52854	*06168	1.*19092	1.*19231	*.12525	*.42111
*.58405	*05627	1.*16878	1.*16997	*.12290	*.36845
*.63607	*05100	1.*16727	1.*16845	*.12274	*.36490
*.68353	*04553	1.*14794	1.*14896	*.12068	*.31982
*.72545	*04061	1.*12006	1.*12085	*.11772	*.25612
*.76099	*03632	1.*12610	1.*12694	*.11836	*.26979
*.78943	*03222	1.*10411	1.*10479	*.11603	*.22042
*.81016	*02945	1.*10451	1.*10518	*.11607	*.22129
*.82277	*02781	1.*05447	1.*05480	*.11077	*.11257
*.82700	*02730	1.*06240	1.*06202	*.11157	*.12865

VISCID FLOW SOLUTION

NACA 23012 W SLOT, NASA-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

MACH NUMBER= .10500 ANGLE OF ATTACK= 0.0000 DEG.

X	Z	(W/W0) INC.	(V/V0) COMPRESSIBILITY	ML	CP	ITERATION NUMBER	COMPONENT NUMBER	LOWER SURFACE
1.02597	-0.04578	.76830	.76742	.78054	.41153			
1.02448	-0.04580	.86213	.86151	.09043	.25798			
1.01715	-0.04557	.88857	.88805	.09322	.21150			
1.00524	-0.04511	.91500	.91458	.09601	.16361			
.98922	-0.04447	.93734	.93702	.09837	.12203			
.96971	-0.04361	.96088	.96068	.10086	.07712			
.94752	-0.04205	.94480	.94452	.09916	.10792			
.92345	-0.04031	.93103	.93069	.09771	.13387			
.89843	-0.03845	.91738	.91697	.09627	.15923			
.87340	-0.03663	.91143	.91101	.09564	.17015			
.84938	-0.03453	.88770	.88717	.09313	.21305			
.82726	-0.03240	.84303	.84235	.08842	.29067			
.80784	-0.03084	.86334	.86273	.09056	.25589			
.79198	-0.02886	.88265	.88211	.09260	.22202			
.78042	-0.02566	.80145	.80066	.08404	.35930			
.77364	-0.02093	.39507	.39414	.04135	.84652			
.77203	-0.01392	.41870	.41774	.04382	.82737			

VISCID FLOW SOLUTION

NACA 23012 W SLOT , NAS1-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

MACH NUMBER= .10500 ANGLE OF ATTACK= 0.000 DEG.

X	Z	(V/V0)INC.	(V/V0)ML	(V/V0)CP	ML	CP	ITERATION NUMBER 4	UPPER SURFACE COMPONENT NUMBER 2
.77533	-.00740	.76707	.76620	.08041	*41341			
*.78355	-.00065	.82940	.82868	.08698	*31356			
*.79631	.00576	.91910	.91870	.09645	*15606			
*.81300	.01052	.10980	.11051	.11663	*23309			
*.83287	.01252	.1.26564	.1.26776	.1.3320	*.60620			
*.85509	.01123	1.34944	1.35253	.14215	*.82743			
*.87866	.00550	1.22176	1.22343	.12853	*.49611			
*.90300	-.00186	1.15165	1.15270	.12108	*.32841			
*.92718	-.01048	1.03604	1.03625	.10881	*.07379			
*.95051	-.01816	1.00941	1.00946	.10600	*.01901			
*.97198	-.02544	.97766	.97754	.10264	*.04442			
*.99175	-.03223	.93244	.93210	.09786	*.13123			
1.00610	-.03820	.85178	.85113	.08934	*.27578			
1.01754	-.04238	.80033	.79953	.08392	*.36111			
1.02429	-.04492	.67447	.67344	.07067	*.54730			
1.02697	-.04578	.76830	.76742	.08054	*.41153			

LAMINAR BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT , NAS1-9143

CORRELATION CASE 8,9-29-70, 10-DEG FLAP

 UPFFR SURFACE
 COMPONENT NUMBER 1
 ITRATION NUMBER 4

	X/C	S/C	N	M	D/D(S/C)	H	THETA/C	DELTA/C	CF
STAGNATION TEMPERATURE	=	518.70	DEGREES, RANKINE	,					
FREESTREAM MACH NUMBER	=	* 10500	MILLION	*					
REYNOLDS NUMBER PER FOOT	=	1.170000							
HEAT TRANSFER FACTOR K	=	1.0000							
SPEED OF SOUND	=	1116.430	FT/SEC	*					
ANGLE OF ATTACK	=	0.0000	DEGREES	*					
STAGNATION AT X/C	=	-*.00000217		*					
STAGNATION PRESSURE	=								
AIRFOIL CHORD	=								
PRANDTL NUMBER	=								
SEPARATION CORRELATION NO.	=								
KINEMATIC VISCOSITY	=								
STAGNATION AT Z/C	=								

	N	L	REW	SKIN FR/SQRT(REW)	REMOM	CFBAR
-106414	* 389d23	40405.574	* 00999588	77.8841	* 00061285	
-053451	* 3118b1	137495.224	* 00415070	149.8047	* 0009875	
-033318	* 2792+5	258319.496	* 00231864	240.2478	* 00087596	
-023654	* 2632+7	420369.596	* 00162346	322.0929	* 00077426	
-001016	* 218645	601084.947	* 00103231	421.8302	* 00067040	
* 030946	* 155012	797535.777	* 00058671	526.2549	* 00056527	
* 064714	* 064894	987723.273	* 00014308	653.0367	* 00046451	
* 063324	* 0522+5	1195470.897	* 00013617	764.0790	* 00038118	
-070365	* 0111/0	1413073.404	* 00002569	866.8346	* 00031899	
SCRIT/C =	* 11069616	RECIT =	385.97	STRAN/C =	* 30202567	RTRAN =
INSTABILITY TRANSITION HAS OCCURRED AT	X/C =	.2777312	S/C =	* 302026		
CN LAMINAR SEPARATION HAS OCCURRED AT	X/C =	.2777312	S/C =	* 302026		
SHOT BUBBLE TRANSITION REYNOLDS NO. =	829.916124					

= 3322.854

= 2.482

= .7300

= .069619

= .00010014

= .00007052

= .007553

= .006203

= .004047

= .003172

= .00161

= .0002045

= .001135

= .000258

= .000327

= .000256

= .000231

= .000042

= .000064

= .000086

= .000035

= .000052

= .000127

= .000067

= .000086

= .000109

= .000140

= .000169

= .000393

= .000455

= .000196

TURBULENT BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT, NASI-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

UPPER SURFACE
COMPONENT NUMBER 1
INTRATRAN 4

	STAGNATION TEMPERATURE	=	518.70	DEGREES RANKINE	STAGNATION PRESSURE	=	3322.854	LB/SQ FT
	FREE STREAM MACH NUMBER	=	.10500	AIRFOIL CHORD	PRANDTL NUMBER	=	2.482	FT
	REYNOLDS NUMBER PER FOOT	=	1.170000	MILLION	TRANSITION POINT, S/C	=	.7300	
	HEAT TRANSFER FACTOR K	=	1.0000		INIT. INCOMPRESS. FORM FACTOR	=	.30203	
	(INITIAL MOMENTUM THICKNESS) / C	=	.00033				1.33110	
	ANGLE OF ATTACK	=	0.0000	DEGREES				
X/C	S/C			H				
				DM/(S/C)				
				H				
				THETAC				
				DELTA/C				
				CF				
*.277312	*.302026			*.056952	1.331096	*.000326	*.000434	*.000072
*.294832	*.319547			*.055151	1.392077	*.000369	*.000514	*.003773
*.352606	*.377343			*.040663	1.423267	*.000502	*.000715	*.004093
*.411616	*.436434			*.040164	1.403566	*.000625	*.000878	*.005210
*.470670	*.495612			*.034713	1.383975	*.000772	*.001069	*.006637
*.528538	*.553679			*.030496	1.390800	*.000889	*.001236	*.007564
*.584054	*.609427			*.022015	1.370985	*.001029	*.001411	*.009020
*.636066	*.661712			*.022736	1.377311	*.001117	*.001538	*.009694
*.683528	*.709442			*.020683	1.372408	*.001249	*.001714	*.010920
*.725453	*.751692			*.019223	1.376721	*.001362	*.001876	*.012855
*.760989	*.787430			*.017986	1.378365	*.001461	*.002014	*.012781
*.789430	*.816177			*.016995	1.379610	*.001543	*.002128	*.012731
*.810161	*.837103			*.016271	1.380507	*.001603	*.002214	*.012668
*.822770	*.849827			*.015831	1.381047	*.001641	*.002266	*.014161
*.827000	*.854120			*.015683	1.381228	*.001654	*.002284	*.014267

TURBULENT BOUNDARY LAYER SUMMARY FOR EQUIVALENT AIRFOIL

NACA 23012 W SLOT, NAS1-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

UPPER SURFACE
COMPONENT NUMBER
1
INFRATION NUMBER
4

	STAGNATION TEMPERATURE	=	518.70	DEGREES RANKINE	STAGNATION PRESSURE	=	3322.854	L/R/S? FT
	FREE STREAM MACH NUMBER	=	*10500	MILLION	AIRFOIL CHORD	=	2.482	FT
	REYNOLDS NUMBER PER FOOT	=	1.170000		PRANDTL NUMBER	=	*7300	
	HEAT TRANSFER FACTOR K	=	1.0000		TRANSITION POINT, S/C	=	*30203	
	(INITIAL MOMENTUM THICKNESS) / C	=	*00033		INIT. INCOMPRESS. FORM FACTOR	=	1.33110	
	ANGLE OF ATTACK	=	0.0000	DEGREES				
X/C	S/C	H	DH/(S/C)	H	THETA/C	DELTA/C	CF	
.277312	*302026	*135062	-056952	1.331096	*000326	*000434	*000072	
.294832	*319547	*134080	-055151	1.346126	*000369	*000496	*004133	
.352606	*377344	*131064	-040663	1.340647	*000510	*000684	*003844	
.411616	*436431	*129357	-040164	1.340204	*000642	*000860	*003630	
.470670	*495612	*126312	-034713	1.336418	*000799	*001067	*003465	
.528538	*553679	*125250	-030496	1.331485	*000921	*001227	*00360	
.584054	*609427	*122897	-022015	1.325461	*001073	*001422	*003281	
.636066	*661714	*122236	-023937	1.322410	*001164	*001538	*003232	
.683528	*709465	*120683	-038524	1.322117	*001305	*001725	*003145	
.725453	*751692	*119223	-034564	1.321493	*001423	*001881	*003085	
.760989	*787490	*117986	-034564	1.321056	*001527	*002017	*003038	
.789430	*816177	*116995	-034564	1.320785	*001612	*002129	*015405	
.810161	*837106	*116271	-034564	1.320637	*001676	*002213	*016018	
.822770	*849827	*115831	-034564	1.320567	*001715	*002265	*016395	
.827000	*854120	*115683	-034564	1.320546	*001728	*002282	*016523	
							*002957	

LAMINAR BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT, NASA-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

LOWER SURFACE
COMPONENT NUMBER
TERRIFICATION NUMBER 1
NUMBER 4

STAGNATION TEMPERATURE	=	518.70	DEGREES RANKINE	*	STAGNATION PRESSURE	=	3322.854	LB/SQ FT	
FREESTREAM MACH NUMBER	=	.10500	MILLION	*	AIRFOIL CHORD	=	2.482		
REYNOLDS NUMBER PER FOOT	=	1.170000	*	PRANDTL NUMBER	=	.7300	*		
HEAT TRANSFER FACTOR K	=	0.0000	*	SEPARATION CORRELATION NO.	=	.76619	*		
SPEED OF SOUND	=	1116.430	FT/SEC	*	KINEMATIC VISCOSITY	=	.30010014	SQ FT/SFC	
ANGLE OF ATTACK	=	0.0000	DEGREES	*	STAGNATION AT Z/C	=	.00007053		
STAGNATION AT X/C	=	-0.00000217	*						
X/C	S/C	H	DM/D(S/C)	H	THETA/C	DELS/C	DFLT/C	C/F	
.000000	*000073	*000503	6.842120	2.501987	*000022	*000054			
*004458	.010639	.073102	4.615091	2.505857	*000026	*000066			
*017242	.025314	*094847	1.03133	2.444791	*000038	*000093			
*038079	.047031	*101788	*171548	2.412876	*000058	*000141			
*066538	*075933	*101058	-0.07767	2.388957	*000086	*000205			
*1.02080	*111740	*101159	*040750	2.408932	*000109	*000261			
*144005	.153933	*104608	.067936	2.429398	*000123	*000298			
*191440	.201575	*107612	*043805	2.421903	*000136	*000328			
*243391	.253645	*108798	*017131	2.407169	*000153	*000369			
*298799	*309389	*109414	-0.07800	2.383905	*000171	*000409			
*356525	*366627	*107826	*023547	2.357968	*000198	*000467			
*415426	.425732	*106577	-0.03980	2.384709	*000222	*000529			
*474326	*489628	*107357	*022629	2.437728	*000234	*000569			
*532011	*542312	*109288	*022574	2.439384	*000237	*000579			
*587270	*597023	*109959	*039597	2.401402	*000247	*000593			
*638966	*645947	*109767	*114433	2.510710	*000167	*000420			
*686030	.696137	.120089	-297532	2.148311	*000149	*000321			
N	L	REW	SKIN FR/SQRT(REW)	REMOM	CFRAR				
-1.06414	*389823	1.236	2.14939872	.3628	*0000403				
-1.06425	*389447	25911.616	*01216825	64.0202	*00048079				
-0.49124	*305073	79756.737	*00506884	120.1822	*00067490				
-0.019510	*256147	158849.041	*00259039	197.3707	*00069228				
.001908	*216249	254555.497	*00150375	287.9923	*00049549				
-0.15994	*249935	376571.771	*00136387	365.8341	*00040594				
-0.033988	*280524	534072.976	*00131725	425.2822	*00035204				
-0.266923	*268608	719078.829	*00110830	483.8162	*00031613				
-0.013393	*246311	914614.276	*00088588	552.6352	*00028638				
.007628	*205738	1120733.613	*00066050	621.5341	*00025922				
*030730	*155920	1311146.431	*00043861	707.7101	*00023345				
.006509	.020793	1605764.358	*00052940	783.9237	*00021245				

- .041099 .2922.67 1724805.475 .00070170 831.2968 .00019922
- .042312 .29422.2 1964164.218 .00068317 859.4755 .00019072
- .008035 .23561.3 2177515.310 .00052247 899.9375 .00018290
- .106436 .38982.2 2362304.176 .00127947 608.0670 .00018103
.220877 0.0000000 2765118.748 0.00000000 593.4788 .00017647

SCRIT/C = .07156028 RECRIT = 273.52 STRAN/C = *67457688 RTRAN = 597.88 THETAI/C = .00025537

CN LAMINAR SEPARATION HAS OCCURRED AT X/C = .665400 S/C = .674577
SHORT BUBBLE TRANSITION REYNOLDS NO. = 597.875060

TURBULENT BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT + NAS1-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

LOWER SURFACE
COMPONENT NUMBER 1
ITERATION NUMBER 4

STAGNATION TEMPERATURE	=	518.70	DEGREES RANKINE	*	STAGNATION PRESSURE	=	3322.854	LB/SQ FT
FREESTREAM MACH NUMBER	=	.10500		*	AIRFOIL CHORD	=	2.482	FT
REYNOLDS NUMBER PER FOOT	=	1.170000	MILLION	*	PRANDTL NUMBER	=	.7300	
HEAT TRANSFER FACTOR K	=	1.0000		*	TRANSITION POINT, S/C	=	.67458	
(INITIAL MOMENTUM THICKNESS) / C	=	.00026		*	INIT. INCOMPRESS. FORM FACTOR	=	1.39890	
ANGLE OF ATTACK	=	0.0000	DEGREES					
X/C	S/C	H	DW/(S/C)	H	THETA/C	DELS/C	DELTA/C	CF
.665400	.674577	.121340	* 181647	1.398903	* .000255	* .000357	* .000825	
.686030	.696167	.120089	- .297532	1.438168	* .000310	* .000446	* .003804	
.727040	.747040	.076234	- .297794	1.240409	* .001393	* .001731	* .02483	
.761633	.790374	.084158	* .599272	1.220175	* .001070	* .001306	* .016108	
.789639	.820313	.110712	* .552204	1.324201	* .000526	* .000695	* .013167	
.810247	.841065	.117356	* .088134	1.313355	* .000470	* .000617	* .004993	
.822792	.853598	.116704	- .192133	1.350521	* .000504	* .000582	* .004554	
.827000	.857957	.115683	- .287388	1.371226	* .000528	* .000723	* .004567	
							* .004620	
							* .003651	

TURBULENT BOUNDARY LAYER SUMMARY FOR EQUIVALENT AIRFOIL

NACA 23012 W SLOT, NASA-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

LOWER SURFACE
COMPONENT NUMBER 1
ITERATION NUMBER 4

STAGNATION TEMPERATURE	=	518.70	DEGREES RANKINE		STAGNATION PRESSURE	=	3322.854	LB/SQ FT
FREESTREAM MACH NUMBER	=	.10500	MILLION	*	AIRFOIL CHORD	=	2.482	
REYNOLDS NUMBER PER FOOT	=	1.170000		*	PRANDTL NUMBER	=	.7300	
HEAT TRANSFER FACTOR K	=	1.0000		*	TRANSITION POINT, S/C	=	.67458	
(INITIAL MOMENTUM THICKNESS)/C	=	.00026		*	INIT. INCDMPR. FORM FACTOR	=	1.39890	
ANGLE OF ATTACK	=	0.0000	DEGREES					
X/C	S/C	M	DM/(S/C)	H	THETA/C	DELS/C	DELTA/C	CF
.665400	.674577	.121340	.181647	1.398903	.000255	.000357	.0000825	
.686030	.696167	.120089	-.297532	1.421311	.000270	.000383	.002202	.004116
.727040	.747040	.076234	-.297794	2.090569	.001309	.002736	.007753	.001070
.761633	.790374	.084158	*.599272	1.601882	*.001040	*.001665	*.007199	*.002377
.789639	.820313	.110712	*.552204	1.368518	*.000497	*.000680	*.004371	*.003877
.810247	.841065	.117356	*.088134	1.346630	*.000454	*.000612	*.004140	*.004045
.822792	.853598	.116704	-.192133	1.358798	*.000486	*.000661	*.004345	*.003903
.827000	.857857	.115683	-.287388	1.362276	*.000508	*.000692	*.004510	*.003847

LAMINAR BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT, NASA-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

UPPER SURFACE
COMPONENT NUMBER 2
ITERATION NUMBER 4

STAGNATION TEMPERATURE	=	518.70	DEGREES RANKINE	*	STAGNATION PRESSURE	=	3322.854	LR/SQ FT
FREE STREAM MACH NUMBER	=	* 1.0500		*	AIRFOIL CHORD	=	* 771	FT
REYNOLDS NUMBER PER FOOT	=	1.170000	MILLION	*	PRANDTL NUMBER	=	* 7300	
HEAT TRANSFER FACTOR K	=	1. 0000		*	SEPARATION CORRELATION NO.	=	* .069619	
SPEED OF SOUND	=	1116.430	FT/SEC	*	KINEMATIC VISCOSITY	=	* .00010014	SQ FT/SFC
ANGLE OF ATTACK	=	0.0000	DEGREES	*	STAGNATION AT Z/C	=	- .01737360	
STAGNATION AT X/C	=	* .77211140						
x/c	s/c	m	dm/d(s/c)	h	theta/c	del s/c	delta/s/c	cf
.772032	*.002842	*.043823	12.529058	2.503374	*.000016	*.000040		*.005854
.775335	*.010369	*.080414	3.086678	2.459365	*.000025	*.000061		*.005775
.783545	*.020952	*.086981	*.639070	2.430555	*.000042	*.000102		*.003245
.796309	*.035239	*.096447	*.889119	2.476053	*.000051	*.000126		*.003584
.813005	*.052581	*.116634	1.008369	2.482438	*.000049	*.000121		*.004576
.832872	*.072573	*.133204	*.626588	2.459793	*.000052	*.000129		*.004394

N	L	REW	SKIN FR/SQRT(REN)	REM0N	CFBAR
*.106414	*.389823	4160.249	*.03339948	23.3392	*.00492687
*.063896	*.327931	27808.560	*.00982568	66.6781	*.00845792
*.037265	*.286039	60608.253	*.00472296	120.9703	*.00802103
*.077044	*.347613	112872.691	*.00424925	163.3437	*.00709902
*.079974	*.351926	202969.334	*.00372477	188.4934	*.0070266
*.056860	*.317152	318888.717	*.00275229	229.6993	*.00716783

CONFLUENT BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT +NAS1-9143 CORRELATION CASE A,9-29-70, 10-DEG FLAP
 STAGNATION PRESSURE = 3322.854 LR/SO FT
 DEGREES RANKINE = .01520
 MILLION H/C = .82767
 DEGREES X/C = .82767
 SPEED OF SOUND = .430 FT/SFC
 ITERATION NUMBER 2

	X/C	S/C	M	DW/D(S/C)	H	THETA/C	DEL S/C	DELTA/C
CORE REGION								
STAGNATION TEMPERATURE =	518.70							
FREESTREAM MACH NUMBER =	.10500							
REYNOLDS NUMBER PER FOOT =	1.170000							
ANGLE OF ATTACK =	0.00000							
STAGNATION PRESSURE =	145052							
SLOT HEIGHT, H/C =	.626588							
SLOT EXIT, X/C =	1.746400							
SPEED OF SOUND =	.000075							

MAIN REGION-I

*950506	*1946j1	*105996	-217695	1.489107	*000463	*003005	*036759
*971978	*217279	*098904	-.312720	1.589176	*000570	*004123	*039653
*990747	*237246	*092660	-.312720	1.684485	*000746	*005505	*043395
1.006102	*253392	*087517	-.312720	1.746572	*000899	*007227	*046991
1.017543	*265680	*083706	-.312720	1.746572	*001042	*009056	*050340
1.024593	*273380	*081360	-.312720	1.746572	*001143	*010387	*052766
1.026973	*275921	*080566	-.312720	1.746572	*001172	*010629	*053598

LAMINAR BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT • NAS1-9143 CORRELATION CASE #, 9-29-70, 10-DEG FLAP

LWFP SURFACE
COMPONENT NUMBER 2
ITERATION NUMBER 4

	STAGNATION TEMPERATURE	=	518.70	DEGREES RANKINE	? ?	STAGNATION PRESSURE	=	3322.854	LR/SQ FT
	FREESTREAM MACH NUMBER	=	.10500	AIRFOIL CHORD	? ?	AIRFOIL NUMBER	=	.771	FT
	REYNOLDS NUMBER PER FOOT	=	1.170000	MILLION	? ?	SEPARATION CORRELATION NO.	=	.7300	
	HEAT TRANSFER FACTOR K	=	1.0000	FT/SEC	? ?	KINEMATIC VISCOSITY	=	.069619	SQ FT/SFC
	SPEED OF SOUND	=	1116.430	DEGREES	? ?	STAGNATION AT Z/C	=	.0010014	SQ FT
	ANGLE OF ATTACK	=	0.0000	DEGREES	? ?	STAGNATION AT Z/C	=	.01737367	
	STAGNATION AT X/C	=	.77211140	?	?	?	?	?	?
X/C	S/C	M	DW/D(S/C)	H	THETA/C	DELS/C	DELTA/C	CF	CF
.773644	.003919	.041347	8.805283	2.503222	.000019	.000048	.004631		
.780423	.012435	.034036	3.231229	2.466317	.000025	.000063	.006067		
.791983	.024487	.032599	.350480	2.412901	.000042	.000102	.003095		
.807836	.040481	.030561	-.119525	2.369892	.000067	.000158	.001370		
.827259	.059866	.0388419	-.040471	2.401546	.000090	.000217	.001286		
.849376	.082192	.0391132	.160176	2.443134	.000095	.000231	.001625		
.873399	.106349	.056338	.065246	2.416631	.000104	.000252	.001315		
.898428	.131398	.096265	.041247	2.411614	.000118	.000284	.001137		
.923452	.156490	.097708	.058922	2.425716	.000127	.000308	.001161		
.947520	.180648	.099163	.068690	2.436503	.000134	.000327	.001178		
.969708	.202802	.100862	-.032185	2.368157	.000139	.000328	.000709		
.989219	.222361	.098374	-.138349	2.263000	.000158	.000357	.000000		

N	L	REW	SKIN FR/SQRT(REW)	REMOM	CFBAR
-106414	.389823	5413.943	.02967386	26.2706	.00389736
-069756	.336772	34767.141	.00945743	71.1338	.00739459
-020120	.258240	7534.025	.00397898	129.5934	.00755059
.017706	.184918	121856.527	.00184038	200.6703	.00605202
-011012	.241032	176293.280	.00181257	265.5985	.00481195
-047845	.303035	25434.847	.00206578	292.9609	.00417341
-023395	.263339	337695.878	.00158562	331.6244	.00378806
-019102	.255339	420090.118	.00135295	376.9230	.00345878
-031601	.276094	507692.600	.00134214	411.6239	.00321433
-041115	.292293	594560.350	.00132252	441.2533	.00304801
-020589	.178689	679045.477	.00076899	463.8928	.00288796
.114776	0.000000	723345.958	0.00000000	515.4001	.00268682
SCRIT/C =	.03822495	RECIT =	190.16	STRAN/C =	.21519930
ON LAMINAR SEPARATION HAS OCCURRED AT	X/C =			RTRAN =	494.98
				S/C =	.215199

TURBULENT BOUNDARY LAYER SUMMARY

NACA 23012 W SLOT • NAS1-9143 CORRELATION CASE 8.9-29-70, 10-DEG FLAP

LOWER SURFACE F
COMPONENT NUMBER 2
ITERATION NUMBER 4

STAGNATION TEMPERATURE	=	518.70	DEGREES RANKINE	,	STAGNATION PRESSURE	=	3322.854	LB/SQ FT
FREESTREAM MACH NUMBER	=	.10500			AIRFOIL CHORD	=	.771	
REYNOLDS NUMBER PER FOOT	=	1.170000	MILLION		PRANDTL NUMBER	=	.7300	
HEAT TRANSFER FACTOR K	=	1.0000			TRANSITION POINT, S/C	=	.21520	
(INITIAL MOMENTUM THICKNESS) / C =	=	.00025			INIT. INCOMPRESS. FORM FACTOR	=	1.34659	
ANGLE OF ATTACK	=	0.0000	DEGREES					
X/C	S/C	H	DM/(S/C)	H	THETA/C	DELS/C	DELTA/C	CF
.982040	.21519	.099339	-.130353	1.346595	.000255	.000343	.002362	.000314
.989219	.222381	.098374	-.138349	1.398369	.000281	.000392	.000523	.004459
1.005239	.238408	.096014	-.385360	1.524805	.000343	.000469	.000819	.003420
1.017145	.250315	.089319	-.739139	1.735212	.000469	.001216	.0013029	.002221
1.024483	.257637	.083111	-.956666	2.040572	.000609	.001393	.003632	.000896
1.026973	.260196	.080566	-1.032698	2.178851	.000669		.003932	.000328

TURBULENT BOUNDARY LAYER SUMMARY FOR EQUIVALENT AIRFOIL					
NACA 23012 W SLOT , NASI-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP					
LOWER SURFACE					
COMPONENT NUMBER				2	
ITERATION NUMBER				4	
STAGNATION TEMPERATURE	=	518.70	DEGREES RANKINE		
FREESTREAM MACH NUMBER	=	.10500			
REYNOLDS NUMBER PER FOOT	=	1.170000	MILLION		
HEAT TRANSFER FACTOR K	=	1.0000			
INITIAL MOMENTUM THICKNESS/C =	=	.00025			
ANGLE OF ATTACK	=	0.0000	DEGREES		
X/C	S/C	M	DN/(S/C)	H	THETA/C
					DELTA/C
					CF
9.82040	.21519	.099339	-.130353	1.346595	.000343
.989219	.222381	.098374	-.138349	1.367013	.000255
1.005239	.238406	.096014	-.385360	1.422107	.000335
1.017145	.250315	.089319	-.739139	1.571007	.000444
1.024483	.257637	.083111	-.956666	1.918894	.000567
1.026973	.260196	.080566	-1.032698	2.090569	.000628
					.001313
					.001284
					.001222
					.000314
					.004686
					.002450
					.004118
					.002731
					.003138
					.003085
					.001710
					.001459
					.001089
					.001313
					.001284

LOADS SUMMARY SHEET

NACA 23012 W SLOT , NAS1-9143 CORRELATION CASE 8,9-29-70, 10-DEG FLAP

MACH NUMBER =	*1.05000	ANGLE OF ATTACK =	0.000000
REYNOLDS NUMBER/FT =	1.170000 MILLION	REFERENCE CHORD =	3.000000

ITERATION NUMBER 4

COMPONENT
LOCATION OF NOSE
X= *000000
Z= -000000

CHORD= COMPONENT DEFLECTION=
2*482351
-1.890698

NORMAL FORCES {CN) PRESS.= *408959

AXIAL FORCES {CA) PRESS.= *000970
(CA) SHEAR = *003653
CA = *004623

MOMENT ABOUT THE NOSE {CM) PRESS.= *118227

TOTAL LIFT COEFFICIENT= *496560
TOTAL DRAG COEFFICIENT= -.0003432
TOTAL MOMENT COEFFICIENT= -.192991
(ABOUT THE POINT (0,0))

COMPONENT 1 2

*000000
2.316095
-.041772

*770772
7.122004

*087669

-.013987
*00516
-.005471

*007004

APPENDIX B

Appendix B is a computer program listing of the program as set up on the Langley Research Center's CDC 6600 computer. The portions of the program related to the core overlay structure will vary with other computer systems. The column of numbers on the far right are sequential numbering of the card images where the last five digits are for program updating.

A computer deck of this program (ask for program number LAR-10939) can be obtained by domestic users for a service charge from the following address:

Computer Software Management and Information Center (COSMIC)
Computer Center
The University of Georgia
Athens, Georgia 30601
PHONE: 404-542-3265

```

SECTION(SEC1,POINT,SLOPE,TRANS)
SECTION(SEC2,PLOT,SCALE,CUTTER)
SECTION(SEC3,LAMNA2,TURB,BLTRAN,CONF5,CONF7,CONF8,SLOTFL,YDERS)
SECTION(SEC4,PLOT CP,SCALE,CUTTER,GRID)
SECTION(SEC5,PLOTBL,SCALE,CUTTER,GRID)
SECTION(SEC6,VOVBT,INFLU,GJRV,THICK)
SEGZERO(SEQ0,MAIN)
SEGMENT(SEG1,READIT,GEOM,ROTRAN,INTEG,SEC1,ASLOT,LSQ)
SEGMENT(SEG2,MAIN2)
SEGMENT(SEG3,CONPT,EQUIV,SMOOTH)
SEGMENT(SEG4,COEFF,INFLU,VORTEX,GJRV)
SEGMENT(SEG5,CCMPK,STAG,SEC1,SEC6,SLOTFL,YDERS)
SEGMENT(SEG6,MAIN3,COMPK,SEC1,LSQ,PRJOT,LUAD,TURB2,SEC3,DLIM)
SEGMENT(SEG7,SEC1,SEC6)
PROGRAM MAIN(INPUT,OUTPUT,TAPE5=INPUT,TAPE6,TAPE7=OUTPUT)
COMMON XLUDTH(4,2),NXUPTH(4,2),C(4),XCT(165),ZCT(165),THETA(165),
IS(165),XPC(165),ZPCT(165),NC,FILE(8),ALFA,FSMACH,VOV(165),
2VT(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),TSTAG(4),SSTAG(4),
3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PK,NCU,IPLIT,
4CF(165),DLTAS(165),CREF,THICK(165),GVBT(165),VVBT(165),
SOLIASP(165),GVBD(165),VVBD(165),VVBDP(165),CN(4,10),
6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2),
7,ISLCI(3)
DIMENSION ALPHA(5),FSMACH(5),XPP(12),ZPP(12)
DIMENSION ASEG(2)
DIMENSION IB(6)
DIMENSION WORD(14),IWORD(14)
EQUIVALENCE (WORD,IWORD)
DATA IPLOT/0/
DATA LFILE/3HL GU/
DATA (IB(I),I=1,6)/6*0/
DATA IEND/6H*****/
IC=6
REWIND ID
M=7
MAP=1
IBI=52
CALL SYSTEMC(1IBI,IE)
CALL CALCM(1I,D2,JZ,-3)
C 1C CONTINUE
RAD=57.2957795
ASEG(2)=0

```

```

43000000
44000000
45000C0
4600000
47C0000
4800000
4900000
5000000
5100000
5200000
5300000
5400000
55000C0
5600000
5700000
5800000
5900000
6000000
6100000
6200000
6300000
6400000
6500000
6600000
6700000
6800000
6900000
7000000
7100000
7200000
7300000
7400000
7500000
7600000
7700000
7800C0
7900000
8000000
8100000
8200000
8300C0
8400000
8500000

ASEG(1)=4HSEG1
CALL SEGMENT(FILE,1,ASEG,O,MAP)
INPLI
CALL READI(IERR,NA,ALPHA,NM,FSMACH,HSEP,XPP,ZPP)
IF(IERR)60,20,60
20 CONTINUE
ASEG(1)=4HSEG7
ASEG(2)=0
CALL SEGMENT(FILE,1,ASEG,O,MAP)
IFLAG=0
CALL VOVBT(IERR,IFLAG)
IF(IERR.LT.0) GO TO 60
IF(IPLIT.GT.0) IPLCT=1
IPFLAG=0
DC 50 I=1,NN
FSMCH=FSMACH(1)
DC 50 J=1,NA
ICHEK=0
ALFA=ALPHA(J)/RAD
NN=NXUP TH(NC,2)
DC 49 L=1,NN
CF1(L)=C.
DLIAS(L)=0.
DLASP(L)=0.
GVBC(L)=0.
GVBCF(L)=0.
VVBDC(L)=0.
VVBCP(L)=0.
XPC1(L)=XCT(L)
ZPC1(L)=ZCT(L)
KMAX=6
MAXK=KMAX
DC 1C0 K=1,MAXK
ISEP=0
IPFLAG=C
ASEG(1)=4HSEG2
ASEG(2)=0
CALL SEGMENT(FILE,1,ASEG,O,MAP)
CALL MAIN2(IERR,IPFLAG,K,XPP,ZPP)
IF(IERR)60*40,60
ASEG(1)=4HSEG6
ASEG(2)=0
CALL SEGMENT(FILE,1,ASEG,O,MAP)

```

```

8600000
8700000
8800000
8900000
9000000
9100000
9200000
9300000
9400000
9500000
9600000
9700000
9800000
9900000
10000000
10100000
10200000
10300000
10400000
10500000
10600000
10700000
10800000
10900000
11000000
11100000
11200000
11300000
11400000
11500000
11600000
11700000
11800000
11900000
12000000
12100000

C CALL MAIN3(IPFLAG,HSEP,K,ISEP)
C TO PRINT QR NOT TO PRINT--THAT IS THE QUESTION
    IF(K.EQ.1) GO TO 9C
    IF(K.EQ.MAXK) GO TO 90
    IF(K.LE.4) GO TO 90
    IF(ISEP.GT.0) ICHEK=1
    IF(ISEP.GT.0) GO TO 90
    DC 95 L=1,NC
    IF(AES(CN(L,K)-CN(L,K-1))-0.01)97,97,95
    ICHEK=1
97   GO TO 90
95   CONTINUE
    GC TO 1C0
90   WRITE(1C,1000)IEND
    WRITE(1C,1000)IEND
    WRITE(1C,1000)IEND
    WRITE(1C,1000)IEND
    WRITE(1C,1000)IEND
    WRITE(1C,1000)IEND
    WRITE(1C,1000)IEND
    END FILE ID
    REWIND ID
    READ(1D,1000) WORD
    IF(WORD(1).EQ.IEND) GO TO 80
    WRITE( M,1C00) WORD
    GC TO 7C
80   REWIND ID
110  MAP=0
    IF(ICHEK.EQ.1) GO TO 50
100  CONTINUE
    50  CONTINUE
    GO TO 10
    60  CONTINUE
C CLOSE PLOT FILE
    IF(IFLGT.GT.0) CALL CALCM(0.,0.,9999,2)
    STOP
    END

```

```

SUBROUTINE READIT(IERR,NNA,ALPH,NNM,FFSM,HSEP,XPP,ZPP)
C
C      READING SEQUENCE . . . .
C      CALL READIT(IERR,NNA,ALPH,NNM,FFSM,HSEP)
C      IERR INDICATES ERRORS IN THE INPUT. NNA IS THE NUMBER OF
C      ANGELS OF ATTACK WHICH WERE INPUT. ALPH IS THE ANGLES OF
C      ATTACK. NNM IS THE NUMBER OF FREE STREAM MACH NUMBERS WHICH
C      WERE INPUT. FFSM IS THE MACH NUMBERS. HSEP IS THE SEPARATION
C      FCRN FACTOR
C
C      *NOTE    THE OUTPUT OF THIS ROUTINE IS TRANSFERRED BY
C      CMMCN/NPUT/
C
C      CMMCN/NPUT/TITLE(8),NC,NSP,NPP(4),NXU(4),NXL(4),XP(12),ZP(12),
C      LX(310),Z(310),IM,IC(3),IPP(3),ICR(3),IPPR(3),DELTA(3),
C      ZNA,ALPHA(5),NM,FSMACH(5),NXLD(4,2),NXUP(4,2),IPLOT,WORDS(3),
C      3,ICF(3),XSF(3),ZSF(2),CR
C      CMMCN NXLCITH(4,2),NXUPTH(4,2),C(4),XCT(165),ZCT(165),THETA(165),
C      LS(165),XPCI(165),ZPCT(165),NNC,TITL(8),ALFA,FSMCH,VDV(165),
C      2VT(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),TSTAG(4),SSTAG(4),
C      3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,IPLT,
C      4CFI(165),DLTASI(165),CREF,THCK(165),GVBT(165),VVBT(165),
C      5DLIASP(165),GVBD(165),VVBD(165),VVBDP(165),CN(4,10),
C      6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2)
C      7,ISLOT(3)
C      DIMENSION XTL(4),SLR(2)
C      REAL KF
C      DIMENSION ALPH(5),FFSM(5)
C      DIMENSION XND(3),XPP(1),ZPP(1)
C      DIMENSION ITL(8)
C      EQUIVALENCE ITL,TITLE
C      DATA IEND/10HTHE END /
C      DATA SUR/6HUPPER *6HLOWER /
C      DATA XTL/5HXL = ,5HZU = ,5HXL = ,5HZL = /
C      IT=6
C      NCU=0
C      DC 5 I=1,3
C      ISLC(1)=0
C
C      12200000
C      12300000
C      12400000
C      12500000
C      12600000
C      12700000
C      12800000
C      12900000
C      13000000
C      13100000
C      13200000
C      13300000
C      13400000
C      13500000
C      13600000
C      13700000
C      13800000
C      13900000
C      14000000
C      14100000
C      14200000
C      14300000
C      14400000
C      14500000
C      14600000
C      14700000
C      14800000
C      14900000
C      15000000
C      15100000
C      15200000
C      15300000
C      15400000
C      15500000
C      15600000
C      15700000
C      15800000
C      15900000
C      16000000
C      16100000
C      16200000
C      16300000

```

```

1CF(I)=I
XSF(I)=C.
DC 5 J=1,2
FF(I,J)=0.
IF(J.EQ.1) FF(I,J)=C.5
5  CCNTINUE
HSEP=2.45

C NXUP(I,1)=SUBSCRIPT OF START OF UPPER SURFACE FOR COMPONENT I
C NXUP(I,2)=SUBSCRIPT OF END OF UPPER SURFACE FOR COMPONENT I
C NXLC(I,1)=SUBSCRIPT OF START OF LOWER SURFACE FOR COMPONENT I
C NXLC(I,2)=SUBSCRIPT OF END OF LOWER SURFACE FOR COMPONENT I
C
IERR=0
C
C INITIALIZE THE PIVOT POINT ARRAYS
C
DC 10 J=1,12
XP(J)=0.
ZP(J)=0.
1C
C READ THE CASE TITLE
C
READ (5,20C) TITLE
IF(ILL(1).EQ.IEND) GO TO 190
C
C NC IS THE NUMBER OF COMPONENTS, NSP IS THE NUMBER OF SURFACE
C FCIANTS TO BE USED IN CALCULATING, IPLOT AND WORDS ARE FOR THE
C FLCT OPTCN
C
READ (5,21C) NC,NSP,IPLOT,WORDS
WRITE(1,260) TITLE,NC,NSP,IPLOT
260  FGRMAT(1H1,52X,26H***** CASE INPUT *****,/25X,8A10 , /
14X,5HNC = ,I4,6X,6HNSP = ,I4,3X,8HIPLOT = ,I4 )
WRITE(1,270)
270  FGRMAT(25H0 I NPP(I) NXU(I) NXL(I))
IPLT1=IPLOT
IF (NSP.GT.165) GO TO 120
IF ((NC.GT.4).OR.(NC.LE.0)) GO TO 120
NCL=NC-1
NF2=C
NL2=J
DC 30 I=1,NC

```

```

C FOR THE I-TH COMPONENT--NPP IS THE NUMBER OF PIVOT POINTS, NXU
C AND NXL ARE THE NUMBER OF UPPER AND LOWER SURFACE ELEMENTS INPUT
C
C READ (5,220) NPP(I),NXU(I),NXL(I)
C WRITE(UNIT,280) I,NPP(I),NXU(I),NXL(I)
C
C 280 FORMAT(13,3I7)
C IF (NPP(I).EQ.0) GO TO 20
C IF ((NPP(I).GT.NC1).OR.(NPP(I).LT.0)) GO TO 120
C NPL=2*(I-1)+1
C NP2=NPL+NPP(I)-1
C
C XP AND ZP ARE THE PIVOT POINT COORDINATES
C
C READ (5,230) (XP(J),ZP(J),J=NPL,NP2)
C WRITE(UNIT,281) (XP(J),ZP(J),J=NPL,NP2)
C
C 281 FORMAT( 5X, 8HXP,ZP = ,6E13.6)
C
C 20 NL1=NL2+1
C NU2=NXU(I)+NL2
C NL1=NU2+1
C NL2=NXL(I)+NU2
C IF (NL2.GT.310) GO TO 120
C
C X AND Z ARE THE SURFACE COORDINATES--STORED CONSECUTIVELY
C
C READ (5,230) (X(L),L=NU1,NU2)
C WRITE(UNIT,290) XIL(I), (X(L),L=NU1,NU2)
C READ (5,230) (Z(L),L=NU1,NU2)
C WRITE(UNIT,290) XIL(2), (Z(L),L=NU1,NU2)
C READ (5,230) (X(L),L=NU1,NU2)
C WRITE(UNIT,290) XIL(3), (X(L),L=NU1,NU2)
C READ (5,230) (Z(L),L=NU1,NU2)
C WRITE(UNIT,290) XIL(4), (Z(L),L=NU1,NU2)
C
C 290 FORMAT(20X,A5.8E13.6/(25X,8E13.6))
C NXUP(I,1)=NU1
C NXLO(I,1)=NL1
C NXLP(I,2)=NU2
C NXLC(I,2)=NL2
C
C 30 CONTINUE
C IM IS THE INDEX OF THE MAIN COMPONENT
C
C READ (5,220) IM

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      WRITE(11,300) IM
      FORMAT(6H0IM = ,I4 /54H0 I     IC(I)    IPP(I)    ICR(I)    IPPR(I)
      1)      DELTA/I)
      IF (IC1) 120,7C,40
      40 DG 50 I=1,NC1
C
C   IC IS THE COMPONENT INDEX, IPP IS THE PIVOT POINT INDEX,
C   ICR IS THE REFERENCE COMPONENT INDEX, IPPR IS THE REFERENCE
C   PIVOT POINT INDEX, DELTA IS THE DEFLECTION BETWEEN THIS
C   COMPONENT AND THE REFERENCE COMPONENT
C
      READ (5,220) IC(I),IPP(I),ICR(I),IPPR(I),DELTA(I)
      WRITE(11,310) I,IC(I),IPP(I),ICR(I),IPPR(I),DELTA(I)
      310 FORMAT(13,4I10,F13.6)
      50 CONTINUE
      DO 60 I=1,NC1
      II=ICF(I)
      N1=NXUP(II,1)
      N2=NXUP(II,2)
      60 XND(II)=(XSF(II)-X(N1))/(X(N2)-X(N1))
C
C   INPUT THE ANGLES OF ATTACK IN DEGREES
C
      70 READ (5,220) NA
      IF ((NA.GT.5).OR.(NA.LE.0)) GO TO 120
      READ (5,230) (ALPHA(I),I=1,NA)
      WRITE (11,320) NA,(ALPHA(I),I=1,NA)
      320 FORMAT(7HO NA = ,I3,6X,8HALPHA = , 5E13.6)
C
C   INPUT THE MACH NUMBERS
C
      READ (5,220) NM
      IF ((NM.GT.5).OR.(NM.LE.0)) GO TO 120
      READ (5,23C) (FSMACH(I),I=1,NM)
      WRITE(11,330) NM,(FSMACH(I),I=1,NM)
      330 FORMAT(7HO NM = ,I3,5X,9HFSMACH = , 5E13.6)
C
C   CREF IS THE REFERENCE CHORD FOR NONDIMENSIONALIZING THE OUTPUT
C   AND SF IS THE SCALE FACTOR TO CONVERT THE INPUT TO FEET
C
      READ (5,230) CREF,SF
      CR=CREF
      DG 8C I=1,NL2

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```

X(I)=X(I)*SF
8C Z(I)=Z(I)*SF
DC 90 I=1,NP2
XP(I)=XP(I)*SF
90 ZF(I)=ZF(I)*SF
DC 100 I=1,NC1

C READ THE BOUNDARY LAYER INPUT--TO IS THE STAGNATION TEMPERATURE,
C RN IS THE REYNOLDS NUMBER PER FOOT IN MILLIONS, PR IS THE
C PRANDTL NUMBER, KF IS THE HEAT TRANSFER FACTOR
C

100 XSF(I)=XSF(I)*SF
    READ (5,23C) TO,RN,PR,KF
    WRITE(11,340) CREF,SF,TO,RN,PR,KF
340  FCRNAT(8H)CREF = ,E13.6,8H SF = ,E13.6,8H TO = ,E13.6,
     18H RN = ,E13.6,8H PR = ,E13.6,8H KF = ,E13.6)
    WRITE(11,350)
350  FCRNAT(4H0 I,20X,5HTRAN,8X,5HTRAN,11X,5HTRAN//)
    DC 115 I=1,NC

C LTRAN=0 BOUNDARY LAYER TRANSITION IS FREE, =1 TRANSITION IS
C FIXED AT (XTRAN,ZTRAN)
C

DC 110 J=1,2
110 READ (5,240) LTRAN(I,J),XTRAN(I,J),ZTRAN(I,J)
    WRITE(11,360) I,( SUR(J),LTRAN(I,J),XTRAN(I,J),ZTRAN(I,J),J=1,2)
360  FFORMAT(1X,13,3X,A6,7HSURFACE,5X,I2,5X,E13.6,3X,E13.6/7X,A6,
     17HSURFACE,5X,I2,5X,E13.6,3X,E13.6)
115  CONTINUE
    IF(NC1.EQ.0) GO TO 130
    READ(5,220)(ISLOT(I),I=1,NC1)
    WRITE(11,370) (ISLOT(I),I=1,NC1)
370  FFORMAT(9HCISLOT = ,317 )
    GO TO 120
12C WRITE(11,250)
    IERR=7
130  CONTINUE
    IF (IEKR) 18C,140,180
140  NNA=NA
    NNM=NM
    NNC=NC
    DC 15C I=1,NNM
15C  FFSW(I)=FSMACH(I)

```

```

DC 160 I=1,NNA
160 ALPH(I)=ALPHA(I)
      DU 170 I=1,8
17C TITL(I)=TITLE(I)

C   REARRANGE THE GEOMETRY FOR COMPUTATION
C   CALL GECM(IERR,XPP,ZPP)

C   COMPUTE THE SLOT CROSS-SECTION AREAS
C   CALL ASLOT(IERR,ICF,XSF,ZSF,XND)

18C RETURN
19C IERR=-7
      RETURN

C   200 FORMAT(8A1C)
210 FFORMAT(3I5,35X,3A10)
220 FFORMAT(4I5,F10.0)
230 FFORMAT(8F10.0)
240 FFORMAT(1I10,3F10.0)
250 FFORMAT(17H0INPUT CARD ERROR)
      END
      33600000
      33700000
      33800000
      33900000
      34000000
      34100000
      34200000
      34300000
      34400000
      34500000
      34600000
      34700000
      34800000
      34900000
      35000000
      35100000
      35200000
      35300000
      35400000
      35500000
      35600000
      35700000
      35800000

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SUBROUTINE GEOM(IERR,XPP,ZPP)
C
C      ROUTINE TO CONVERT THE GEOMETRY ARRAYS FROM THE INPUT FORM
C      TO THE COMPUTATION FORMS
C
C      CALLING SEQUENCE.....
C      CALL GECM(IERR)
C      IERR IS AN ERROR FLAG WHICH IS EXPLAINED IN THE FORMATED
C      OUTPUT
C
C      *NOTE: THE INPUT TO THIS ROUTINE IS IN COMMON/INPUT/
C      THE OUTPUT IS IN THE BLANK COMMON ARRAYS NXLUTH,
C      NXUPTH,C,XCT,ZCT,THETA,S,XPCT,AND ZPCT
C
C      COMMON NXLGTH(4,2),NXUPTH(4,2),C(4),XCT(165),ZCT(165),THETA(165),
C      LS(165),XPCT(165),ZPCT(165),N7,TITL(8),ALFA,FSMACH,VOV(165),
C      2VT(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),TSTAG(4),SSTAG(4),
C      3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,IPLT,
C      4CFI(165),DLTAS(165),CREF,THCK(165),GVBT(165),
C      5DLIASP(165),GVBD(165),VVBD(165),VVBDP(165),CN(4,10),
C      6MAP,CK(5,3,2),XIS(3,2),XF(3,2),FF(3,2),
C      7*ISLCT(3)
C      DOUBLE PRECISION A
C      COMMON/TEMP/XTEMP(310),ZTEMP(310)
C      CLMFLN/INPUT/TITLE(8),NC,NSP,NPP(4),NXU(4),NXL(4),XP(112),ZP(112),
C      1X(310),Z(310),IM,IC(3),IPP(3),ICR(3),IPRK(3),DELT(3),
C      2NA,ALPHA(5),NM,FSMACH(5),NXLD(4,2),NXUP(4,2),IPLOT,WORD(3),
C      3*ICF(3),XSF(3),ZSF(2),CR,
C      DIMENSION NXLUT(4,2),NXUPT(4,2),XN(4),ZN(4),ANG(4),ICUMP(4),
C      1TEMP(310),DS(310),A(4),NCTH(4),
C      1*XPP(1),ZPP(1)
C      DATA PI/3.1415927/
C
C      SET UP AND PRINT OUT THE INPUT GEOMETRY
C
DC 5 I=1,310
XTEMP(I)=0.
ZTEMP(I)=0.
CALL ROTRAN (NXUP,NXLO,X,Z,L,XTRAN,ZTRAN,MAP)
K=0

```

```

11 I=7
      NC1=NC-1

C   C   REARRANGE THE ORDINATES TO GO FROM LOWER SURFACE TRAILING EDGE
C   C   TO UPPER SURFACE TRAILING EDGE
C
C   DC 50 I=1,NC
C   NXLO(I,I,1)=K+1
C   N1=NXLO(I,I,1)
C   N2=NXLO(I,I,2)

C   C   SAVE THE ORIGINAL NOSE POSITIONS
C
C   XN(I)=X(N1)
C  ZN(I)=Z(N1)
C   N=N2

C   C   STORE THE LOWER SURFACE IN XTEMP,ZTEMP
C
C   DG 1C J=N1,N2
C   K=K+1
C   XTEMP(K)=X(N)
C   ZTEMP(K)=Z(N)
C
C   10 N=N-1
C   NXLC(I,I,2)=K
C   N1=NXUP(I,1)
C
C   C   DOES THE UPPER SURFACE DUPLICATE THE LEADING EDGE POINT--YES,
C   C   DELETE THE DUPLICATE
C
C   IF (XTEMP(K)-X(N1)) 30,20,30
C
C   2C N1=N1+1
C   3C NXUP(I,I,1)=K+1
C   N2=NXUP(I,2)

C   C   STORE THE UPPER SURFACE IN XTEMP,ZTEMP
C
C   DG 40 J=N1,N2
C   K=K+1
C   XTEMP(K)=X(J)
C   ZTEMP(K)=Z(J)
C
C   40 NXUP(I,I,2)=K
C
C   5C CONTINUE

```

```

C PLACE THE LEADING EDGE AT (0,0) AND THE TRAILING EDGE AT (C,0)
C
C C1=0.0
C NCTH1=C,0
C DC 160 I=1,NC
C N1=NXLDT(I,1)
C N2=NXLGT(I,2)
C IF(XTEMP(N2)-XTEMP(N2-1))54,56,53
52 N2=N2-1
53 GC TO 52
54 IF(XTEMP(N2)-XTEMP(N2+1))56,56,55
55 N2=N2+1
56 GC TO 54
C CONTINUE
NN2=N2
N2=NXLDT(I,2)
NPI$=NXUPT(I,2)-N1+1
ANG(I)=ATAN((ZTEMP(N1)-ZTEMP(N2))/(XTEMP(N1)-XTEMP(N2)))
CALL TRANS(XTEMP(N1),ZTEMP(N1),0.,0.,XTEMP(N1),ZTEMP(N1),ANG(I),X
IN(I),ZN(I),NPI$)

C CALCULATE THE COMPONENT CHORD LENGTHS
C
C C(I)=XTEMP(N1)-XTEMP(NN2)
C
C COMPUTE THE ANGLE EQUIVALENT OF X/C--LOWER SURFACE
C
C DC 100 J=N1,N2
C U=2.*((XTEMP(J)-XTEMP(NN2))/C(I))
C IF ((U-1.) 70,60,70
6C TIEMP(J)=PI/2.
GC IC 100
7C TIEMP(J)=ATAN(SQRT(U*(2.-U))/(U-1.))
C IF (TIEMP(J)) 90,80,100
80 IF(J.NE.NN2) GO TO 100
9C TIEMP(J)=TIEMP(J)+PI
10C CONTINUE
N1=N2+1
N2=NXUPT(I,2)

C COMPUTE THE ANGLE EQUIVALENT OF X/C--UPPER SURFACE
C

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        48700000
        48800000
        48900000
        49000000
        49100000
        49200000
        49300000
        49400000
        49500000
        49600000
        49700000
        49800000
        49900000
        50000000
        50100000
        50200000
        50300000
        50400000
        50500000
        50600000
        50700000
        50800000
        50900000
        51000000
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        51800000
        51900000
        52000000
        52100000
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        52300000
        52400000
        52500000
        52600000
        52700000
        52800000
        52900000

DC 150 J=N1 N2
U=2.* (XTEMP(J)-XTEMP(NN2))/C(I)
IF (L-1.) 12C 110,120
11C TTEMP(J)=(3.*PI)/2.
GC TO 150
120 TTEMP(J)=ATAN(SQRT(U*(2.-U))/(U-1.))
IF (TTEMP(J)=PI-TTEMP(J)
130 TTEMP(J)=PI-TTEMP(J)
GC TC 150
140 TTEMP(J)=2.*PI-TTEMP(J)
150 CCNTINUE

C   COMPUTE THE SUM OF THE COMPONENT CHORDS
C
C   CI=C1+C(I)
ICOMP(I)=I
160 CCNTINUE

C   THE OBJECT IS TO SPLIT NSP SURFACE POINTS AMONG NC COMPONENTS
C   SUCH THAT EACH SURFACE OF EACH COMPONENT IS DEFINED BY AN ODD
C   NUMBER OF POINTS WHICH HAS A MINIMUM VALUE OF 11, INCLUDING
C   THE LEADING AND TRAILING POINTS. THIS IMPLIES THE COMPONENT
C   WILL BE DEFINED BY AT LEAST 21 POINTS. ANY ADDITIONAL POINTS
C   ARE ASSIGNED ON THE BASIS OF RELATIVE CHORD LENGTHS.

DC 170 I=1,NC
NCIH(I)=(NSP-2*NC)/4*(C(I)/CT)+5
NCTH(I)=2*NCTH(I)
NCTH(I)=NCTH1+NCTH(I)
IF (NCTH.GT.((NSP-NC)/2)) GO TO 360
17C CCNTINUE

C   WAS THE NUMBER OF POINTS TRUNCATED TO LESS THAN NSP--YES, IS
C   THERE MORE THAN ONE COMPONENT
C
C   IF (NCTH-(NSP-NC)/2) 18C,270,360
18C IF (NC1.GT.0) GO TO 190
NCIH(I)=(NSP-NC)/2
GC TC 270

C   FIND THE COMPONENT WITH THE FEWEST DEFINING POINTS AND RECDER
C
C   190 UC 210 I=1,NC1

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```

N1=I+1
DC 210 J=N1,NC
IF (NCTH(I)-NCTH(J)) 210,210,200
20C INGR=NCTH(I)
NCTH(I)=NCTH(J)
K=ICCMPI(I)
ICCP(I)=ICOMP(I,J)
ICOMF(J)=K
210 CCNTINUE

C   ADD ONE POINT TO EACH SURFACE OF THIS COMPONENT
C
DO 240 I=1,NC1
220 NCTH(I)=NCTH(I)+1
NCTH(I)=NCTH(I+1)
C   CHECK TO SEE IF NSP SURFACE POINTS HAVE BEEN USED
C
IF (NCTH-((NSP-NC)/2)) 230,250,360
230 IF (NCTH(I)-NCTH(I+1)) 220,220,180
240 CCNTINUE

C   RETURN COMPONENT POINT DISTRIBUTION TO ORIGINAL ORDER
C
250 DC 260 I=1,NC
IF (ICOMP(I).EQ.1) GO TO 260
J=ICCMPI(I)
N1=NCTH(I)
NCTH(I)=NCTH(J)
ICCP(I)=I
ICCMF(J)=J
NCTH(J)=N1
260 CCNTINUE

C   COMPUTE THE CONSTANT THETA VALUES AND THE EQUIVALENT X ORDINATES
C
27C N1=0
DC 300 I=1,NC
NXLCIH(I,1)=N1+1
N2=2*NCTH(I)+1
DC 290 J=1,N2
N1=N1+1
53000000
53100000
53200000
53300000
53400000
53500000
53600000
53700000
53800000
53900000
54000000
54100000
54200000
54300000
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56600000
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56800000
56900000
57000000
57100000
57200000

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      IF(ETA(N1)={((J-1)*PI)/NCTH(I)}
      XCT(N1)=C(I)*0.5*{(1.0+COS(THETAIN1))}

C   STORE THE SUBSCRIPT ARRAYS NXLOTH AND NXUPTH
C
      IF (((J-1)-NCTH(I)) 290,280,290
      280  NXLOTH(I,2)=N1
      NXUPTH(I,1)=N1+1
      290  CONTINUE
      NXUPTH(I,2)=N1
      300  CONTINUE
      DC 340 I=1,NC
      N1=NXLOTH(I,1)
      N2=NXUPTH(I,2)
      NN1=NXLOT(I,1)
      NN2=NXUPT(I,2)
      NPIS=NN2-NN1+1
      IF (NPTS.LT.3)  GG TC 370

C   FIND THE Z ORDINATES TO MATCH THE X ORDINATES
C
      DC 310 J=N1,N2
      CALL POINT (ITEMP,ZTEMP,THETA(J),ZCT(J),NN1,NN2,A)
      THCK(J)=ZCT(J)
      CALL SLOPE (THETA(J),A,DS(J))
      DS(J)=SQRT(DS(J)*2+C(I)**2/4.*SIN(THETA(J))**2)
      310 CONTINUE

C   COMPUTE THE SURFACE ARC LENGTHS FROM THE LOWER SURFACE TRAILING
C   EDGE TO THE UPPER SURFACE TRAILING EDGE
C
      CALL INTEG (THETAIN1,THETA(N2),N1,N2,THETA,DS,S,IERR)
      IF (IERR) 320,330,320
      320  WRITE (IT,380)
      RETURN
      330 NPIS=2*NCTH(I)+1

C   RETURN THE REDEFINED COMPONENTS TO THEIR ORIGINAL POSITIONS
C
      ANG(I)=-ANG(I)
      CALL TRANS (XCT(N1),ZCT(N1),ZN(I),XN(I),ZCT(N1),ANG(N1),ANG(I),0.,
      10.,NPTS)
      340 CONTINUE

```

```

C   SET UP AND PRINT CUT THE REDEFINED GEOMETRY
C
C   CALL RUTRAN (NXUPTH,NXLOTH,XCT,ZCT,2,XTRAN,ZTRAN,MAP)
C
DC 365 I=1,12
XFP(I)=XP(I)
ZPP(I)=ZP(I)
NPTS=NXLUTH(INC,2)
DC 350 J=1,NPTS
XCT(J)=XTEMP(J)
XPC(J)=XTEMP(J)
ZCT(J)=ZTEMP(J)
ZFCT(J)=ZTEMP(J)
350 CONTINUE
RETURN
360 IERR=1
ND=(NSP-NC)/2
WRITE (IIT,390) ND
RETURN
370 WRITE (IIT,400)
RETURN
C
380 FORMAT (34H0INTEG CALLED FROM SUBROUTINE GECM)
390 FORMAT (49H0SUBROUTINE GECM. TOTAL NUMBER OF CONSTANT THETA ,
124H X STATIONS GREATER THAN ,I2)
400 FORMAT (49H0NPTS LESS THAN 3 COULD NOT CALL SUBROUTINE POINT)
END

```

```

SUBROUTINE ROTRAN (NXUP,NXLO,X,Z,IOPT,XTRAN,ZTRAN,MAP)
C
C   ROUTINE TO PLACE AIRFOIL COMPONENTS IN MAIN COORDINATE
C   SYSTEM
C
C   CALLING SEQUENCE.....
C   CALL ROTRAN (NXUP,NXLO,X,Z,IOPT,XTRAN,ZTRAN,MAP)
C   NXUP IS THE ARRAY OF UPPER SURFACE INDICES,
C   NXLO IS THE ARRAY OF LOWER SURFACE INDICES,
C   X AND Z ARE THE COMPONENT COORDINATES IN THEIR ORIGINAL
C   SYSTEMS.
C   ICPT IS THE OPTION INDICATOR
C   IOPT=1, COORDINATES ARE INPUT UPPER SURFACE, LEADING
C   TO TRAILING EDGE, LOWER SURFACE, LEADING TO
C   TRAILING EDGE
C   IOPT=2, COORDINATES ARE INPUT LOWER SURFACE, TRAILING
C   TO LEAVING EDGE, UPPER SURFACE LEADING TO
C   TRAILING EDGE
C   XTRAN AND ZTRAN ARE THE COMPONENT COORDINATES IN THE MAIN
C   SYSTEM
C   MAP IS THE MAP OPTION
C   MAP=1, GIVES MAPS OF SEGMENTS CALLED IN THIS ROUTINE
C   MAP=0, GIVES NO MAPS
C
C   *NOTE THIS ROUTINE USES, THE DATA TRANSFERRED IN COMMON
C   /NPUT/ AND /TEMP/
C
C   DIMENSION NXUP(4,2),NXLO(4,2),X(1),Z(1),XPTEMP(12),ZPTEMP(12),
C   IIFIN(4),DEFI(4),XTRAN(4,2),ZTRAN(4,2),
C   CMMCN/NPUT/TITLE(8),NC,NSP,NPP(4),NXU(4),NXL(4),
C   IDUMMY(620),IM,IC(3),IPP(3),ICR(3),IPPR(3),ICR(3),
C   2NA,ALPHA(5),NM,FSMACH(5),DUM(16),IPLOT,WORCS(3),
C   3,ICF(3),XSF(3),ZSF(3),CR
C   CMMCN/TEMP/XTEMP(310),ZTEMP(310)
C   DIMENSION PSEG(2)
C   DATA LFILE/3HL GO/
C   RAD=57.2557795
C   IERR=0
C   IT=6
C   NC1=NC-1

```

```

DC 10 I=1,NC
C
C   PUT MAIN COMPONENT INTO TEMPORARY ARRAYS
C
1C IFIN(I)=0
    IF (IOPT=1) 20,20,30
2C N1=NXUP(IM,1)
N2=NXLQ(IM,2)
GC TO 40
30 N1=NXLQ(IM,1)
N2=NXUP(IM,2)
40 DC 50 I=N1+N2
XTEMP(I)=X(I)
5C ZTEMP(I)=Z(I)
N1=3*(IM-1)+1
N2=N1+NPP(IM)-1
DC 6C I=N1,N2
XTEMP(I)=XP(I)
ZTEMP(I)=ZP(I)
6C ICCUNT=1
IFIN(IM)=1
C
    LINES=60
N1=NXUP(IM,1)
N2=NXUP(IM,2)
N3=NXLQ(IM,1)
N4=NXLQ(IM,2)
NA=N2-N1
NB=N4-N3
NBEG=MINO(N1,N3)
NEND=MAXO(NA,NB)+NBEG
C
C   CLIPUT THE MAIN COMPONENT GEOMETRY
C
DC SC J=NBEG,NEND
IF (LINES=56) 8C,70,70
7C WRITE (IT,230) TITLE
WRITE (IT,240)
WRITE (IT,200)
LINES=6
8C LINES=LINES+1
XINI=XTEMP(N1)/CR
ZINI=ZTEMP(N1)/CR

```

```

XTN3=XTEMP(N3)/CR
ZTN3=ZTEMP(N3)/CR
IF((N1.LE.N2).AND.(N3.LE.N4)) WRITE(IT,210) XTN1,ZTN1,XTN3,ZTN3
IF(N1.GT.N2) WRITE(IT,220) XTN3,ZTN3
IF(N2.GT.N4) WRITE(IT,210) XTN1,ZTN1
N1=N1+1
N3=N3+1
9C CONTINUE
C
C IS THERE MORE THAN ONE COMPONENT
C
C IF (NCL.EQ.0) GO TO 190
C
C TRANSLATE AND ROTATE OTHER COMPONENTS INTO MAIN ORDINATE SYSTEM
C
C IFIN(J)=1 WHEN COMPONENT J IS IN THE MAIN ORDINATE SYSTEM
C
C 1C0 DC 180 I=1.NC1
C
C J IS THE INDEX OF THIS COMPONENT
C
C IS COMPONENT J IN THE MAIN SYSTEM
C
C J=IC(I)
C IF (IFIN(J)) 180,110,180
110 IREFC=ICK(I)
C
C IS THE REFERENCE COMPONENT IN THE MAIN SYSTEM
C
C IF (IFIN(IREFC)) 12C,180,120
C
C FIND THE REFERENCE PIVOT INDEX
C
C 120 IREFP=IPPR(I)
C
C FIND THE INDEX OF THE PIVOT POINT--THIS COMPONENT
C
C IFIV=IPP(I)
C
C PUT THE COMPONENT PIVOT POINTS IN THE MAIN SYSTEM
C
C 77000000

```

```

N1=3*(IREFC-1)+IREFP 77100000
XMS=XPTEMP(N1) 77200000
ZMS=ZPTEMP(N1) 77300000
IFIA(J)=1 77400000
NPTS=NPP(J) 77500000
DEFL(J)=DEFL(J)/RAD 77600000
IF (IREFC.NE.1M) DEFL(J)=DEFL(J)+DEFL(IREFC) 77700000
NPTS=NPP(J) 77800000
N2=3*(J-1)+IPIV 77900000
N1=3*(J-1)+1 78000000
CALL TRANS(XTEMP(N1),ZTEMP(N1),XMS,ZMS,XP(N1),ZP(N1),DEFL(J),XP 78100000
1(N2),ZP(N2),NPTS) 78200000
N1=NINO(NXUP(J,1),NXUP(J,2),NXLO(J,1),NXLO(J,2)) 78300000
N2=NAO(NXUP(J,1),NXUP(J,2),NXLO(J,1),NXLO(J,2)) 78400000
NPTS=N2-N1+1 78500000
N1=NXUP(J,1) 78600000
IF (IOP1.GT.1) N1=NXLO(J,1) 78700000
N2=3*(J-1)+IPIV 78800000
IF (IOP1.GT.1) N1=NXLO(J,1) 78900000
N2=3*(J-1)+IPIV 79000000
C PLACE COMPONENT J IN THE MAIN SYSTEM 79100000
C CALL TRANS(XTEMP(N1),ZTEMP(N1),XMS,ZMS,X(N1),Z(N1),DEFL(J),XP(N2) 79200000
1,ZP(N2),NPTS) 79300000
DC 120 N=1,NCL 79400000
IF (J.NE.ICF(N)) GC TO 130 79500000
CALL TRANS(XSF(N),ZSF(N),XMS,ZMS,XSF(N),ZSF(N),ZP( 79600000
1N2),1) 79700000
79800000
130 CONTINUE 79900000
DC 140 N=1,2 80000000
CALL TRANS(XTRAN(J,N),ZTRAN(J,N),XMS,ZMS,XTRAN(J,N),ZTRAN(J,N),DE 80100000
1FL(J),XP(N2),ZF(N2),1) 80200000
140 CONTINUE 80300000
80400000
C CUTTING THE GEOMETRY FOR COMPONENT J 80500000
C DEL=DEFL(J)*RAD 80600000
LINES=60 80700000
N1=NXUP(J,1) 80800000
N2=NXUP(J,2) 80900000
N3=NXLO(J,1) 81000000
N4=NXLO(J,2) 81100000
81200000
81300000

```

```

NA=N2-N1
NB=N4-N3
NBEG=MINO(N1,N3)
NEND=MAXO(NA,NB)+NBEG

C
DC 170 J=NBEG,NEND
IF (LINES-56) 160,150,150
150 WRITE (IT,230) TITLE
WRITE (IT,250)
XMC=XMS/CK
ZMC=ZMS/CR
XPC=XP(N2)/CR
ZFC=2P(N2)/CR
WRITE(IT,260) XMC,ZMC,XPC,ZPC,DEL
WRITE (IT,200)
LINES 6
16C LINES=LINES+1
XTN1=XTEMP(N1)/CR
ZTN1=ZTEMP(N1)/CR
XTN3=XTEMP(N3)/CR
ZTN3=ZTEMP(N3)/CR
IF((N1.LE.N2).AND.(N3.LE.N4)) WRITE(IT,210) XTN1,ZTN1,XTN3,ZTN3
IF(N1.GT.N2) WRITE(IT,220) XTN3,ZTN3
N1=N1+1
IF(N2.GT.N4) WRITE(IT,210) XTN1,ZTN1
N3=N3+1
170 CCNTINUE

C HAVE ALL COMPCNENIS BEEN TRANSFORMED
C
ICOUNT=ICOUNT+1
IF ((ICOUNT-NC) 180,190,190
180 CCNTINUE
C NOT DONE YET
C
190 GC TO ICO
C SHOULD THE GEOMETRY BE PLOTTED
C
IF ((ICPT.LE.1).OR.(IPLUT.LE.0)) RETURN
C

```

```

C YES--CALL IN THE PLCT SEGMENT
C PSEG(1)=4HSEC2
C PSEG(2)=0
C CALL SEGMENT (LFILE,2,PSEG,O,MAP)
C CALL PLCTR (XTEMP,ZTEMP,NXUP,NXLO,WORDS,DELTA,TITLE,NC,IPLCT)
C RETURN
C
C 20C FCRRMAT (28X,13HUPPER SURFACE,27X,13HLOWER SURFACE/24X,2HXU,18X,2HZ,
C 1U,18Y,2HXL,18X,2HZL/)
C 210 FCRRMAT (10X,4F20.6)
C 220 FCRRMAT (50X,2F20.6)
C 230 FCRRMAT (1H1,25X,8A10)
C 240 FCRRMAT (15+0MAIN COMPONENT//)
C 250 FCRRMAT (IHC,10X,7HX(M.S.),13X,7HZ(M.S.),16X,2HXP,17X,5HDE
C 11TA//)
C 260 FCRRMAT (1X,5F20.6)
C END
C
C 8570000CO
C 85800000
C 85900000
C 86000000
C 86100000
C 86200000
C 86300000
C 86400000
C 86500000
C 86600000
C 86700000
C 86800000
C 86900000
C 87000000
C 87100000
C 87200000
C 37300000
C 37400000

```

```

SUBROUTINE ASLCI(IERR,ICF,XSF,ZSF,XND)
CCMMCN/NPUT/TITL(8),NCC,NSPP,NPP,NPPI(4),NXU(4),XL(4),XO(12),ZP(12),
1X(31C),Z(310),IM,IC(3),IPP(3),ICR(3),IPPR(3),DELTA(3),NA,ALPHA(5),
2NR,FSMACH(5),NXLO(4,2),NXUP(4,2),IPLT,WCRDS(3),NICF(3),SXFS(3),
3SXFS(3),CR
C CMMCN NXLCI(4,2),NXUPTH(4,2),CH(4),XCI(165),ZCI(165),THETA(165),
IS(165),XPCT(165),ZPCT(165),NC,ITITLE(8),ALFA,FSMCH,VOV(165),
2VT(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),SSTAG(4),
3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,IPLOT,
4CFI(165),DTAS(165),CREF,THCKI(165),GVBT(165),VVBT(165),
5DLIASP(165),GVBD(165),VVBD(165),GVBDP(165),VNBDP(165),CN(4,10),
6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2)
7 ISLCT(3)
DIMENSION A(4),DZDX(100),XSFP(100),ZSFP(100),SLOT(100),
1XSAP(100),2SAP(100),B(5),ICF(3),XSF(3),ZSF(3)
DIMENSION XND(3)
DOUBLE PRECISION A
DATA PI/3.14159277/
IERR=0
IT=6
NCI=NC-1
IF(NCI.LE.0) RETURN
DC 1C0 I=1,NC1
IF((ISLOT(1).GT.0)) GO TO 110
N1=NXLTH(1,1)
N2=NXLTH(1+1,2)
N3=NXLTH(1+1,1)
ARG=z*(XCT(N1)-XCT(N2))/(XCT(N3)-XCT(N2))-1.0
IT=z*PI-ACOS(ARG)
CALL POINT(THETA,ZCT,THT,ZAFT,N2,NXUPTH(I+1,2),A)
CK(1,I,1)=ZCT(N1)-ZAFT
CK(1,I,2)=CK(1,I,1)
DC 104 J=2,5
DG 1C4 L=1,2
104 CK(J,I,L)=C.
    IF(XCT(N1)-XCT(N2)) 1C5,1C7,107
1C5   XIS(1,1)=XCT(N1)
        XIS(1,2)=XCT(N2)
        XFS(1,1)=XCT(N1)
        XFS(1,2)=XCT(N2)
        GC 1C 100
1C7   XIS(1,1)=XCT(N2)

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```

XIS(I,2)=XCI(N1)
XFS(I,1)=XCT(N2)
XFS(I,2)=XCT(N1)
GC TO 100
110  CCNTINUE
      WRITE(11,1005) IITLE
      1005 FORMAT(1H1,25X,8A1C)
      IR=I
      IF=I+1
      IF(IICR(I).EQ.IP)  IR=IP
      NR=IP
      IF(IICR(I).EQ.IP)  NR=1
      DC 1  JJ=1,NCL
      KK=JJ
      IF(IC(JJ).EQ.NR)  GO TO 2
      1   CCNTINUE
      NPL=2*(IR-1)+1
      NP2=NPL+IPPR(KK)-1
      XPCC=XP(NP2)/CREF
      ZPCC=ZP(NP2)/CREF
      WRITE(11,1003) I,XPCC,IP,ZPOC,ICR(I),DELTA(KK)
      1003  FORMAT(1H0,58X,13HSLOT GEOMETRY//20X,24HFORE-PIECE IS COMPONENT
      I11,4IX,22HPIVOT POINT IS AT X/C=,F8.4/2IX,23HAFT-PIECE IS COMPONENT
      2T * I1,59X, 4HZ/C=,F8.4/2IX,23HREFERENCE COMPONENT IS ,I1,4IX,
      3I8HDEFLECTION BETWEEN /95X,13HCOMPONENT IS ,F7.3, 8H DEGREES/
      434X,14HFORE-COMPONENT,16X,13HAFT-COMPONENT,14X, 8HSLOT GAP/
      534X,3HX/C,12X,3HZ/C,12X,3HX/C,12X,3HZ/C //)
      C  LOCATE I IN ICF ARRAY
      DC 1C K=1,NCL
      J=K
      IF(ICF(K).EQ.1)  GC TO 15
      10  CCNTINUE
      IERR=-7
      WRITE(11,1001) (ICF(M),M=1,3)
      1001 FORMAT(34HSUBSCRIPT ERROR IN ASLOT  ICF = ,3I5)
      RETURN
      C  15  CCNTINUE
      N1=NXLOTH(I,1)
      N2=NXLCTH(I,2)
      N3=NXUPIH(I,2)
      N41=NXLOTH(I+1,2)
      N42=NXUPIH(I+1,2)
      91700000
      91800000
      91900000
      92000000
      92100000
      92200000
      92300000
      92400000
      92500000
      92600000
      92700000
      92800000
      92900000
      93000000
      93100000
      93200000
      93300000
      93400000
      93500000
      93600000
      93700000
      93800000
      93900000
      94000000
      94100000
      94200000
      94300000
      94400000
      94500000
      94600000
      94700000
      94800000
      94900000
      95000000
      95100000
      95200000
      95300000
      95400000
      95500000
      95600000
      95700000
      95800000
      95900000

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NA3=NXLCTH(I+1,1)
CALL PGINT(XCT,I-ET,A,XCT(N1),THT,NA1,NA2,A)
K1=N1
K2=A(4)+2
XM=(Z.*ZCT(NA1)-ZCT(NA2)-ZCT(NA3))/(Z.*XCT(NA1)-XCT(NA2)-XCT(NA3))
XCIV=0,C02*CH(I)
DZDX(I)=0.
DQ 5C J=1,100
XJ=J-1
XSFP(J)=XCT(N1)-XJ*XDIV
XCC=(XCT(N2)-XSFP(J))/(XCT(N2)-XCT(N1))
XCC=ABS(XOC)
THI=ACOS(2.*XOC-1.)
CALL POINT(THETA,ZCT,THT,ZSFP(J),N1,N2,A)
CALL SLCPE(THT,A,DZTH)
IF(XCT(K1)-XSFP(J)+C.1E-5*CH(I))L8,17,17
L7 K1=K1+1
L8 DZK=(ZCT(K1)-ZCT(K1-1))/(XCT(K1)-XCT(K1-1))
DZKP=(ZCT(K1+1)-ZCT(K1))/(XCT(K1+1)-XCT(K1))
IF(XCT(N1+1)-XSFP(J)) 19,21,21
L9 DZDX(J)=DZK
GC TO 20
L10 DZDX(J)=DZK*(XSFP(J)-XCT(K1))/(XCT(K1-1)-XCT(K1))+1DZKP*(XCT(K1-1)-XSFP(J))/(XCT(K1-1)-XCT(K1))
L20 CCNTINUE
KK=J
L21 IF(DZDX(J)) 25,22,25
L22 DZDX(J)=1.*CE-10
L23 XMJ=(ZCT(K2)-ZCT(K2-1))/(XCT(K2)-XCT(K2-1))
X2=(ZSFP(J)-ZCT(K2)+XSFP(J)/DZDX(J)+XMJ*XCT(K2))/(XMJ+1.0/DZDX(J))
Z2=ZCT(K2)+XMJ*(X2-XCT(K2))
XL=SQR((XCT(K2)-XCT(K2-1))*2+(ZCT(K2)-ZCT(K2-1))*2)
DL=SQR((XCT(K2)-X2)*2+(ZCT(K2)-Z2)*2)
D2=SQR((XCT(K2-1)-X2)*2+(ZCT(K2)-Z2)*2)
IF(XL-D1) 30,32,27
L27 IF(XL-D2) 30,32,32
L30 K2=K2-1
GC TO 25
L32 XSF=(Z2-ZCT(NA1)+X2/XM+XCT(NA1)*XM)/(XM+1.0/XM)
ZSI=Z2-(XST-X2)/XM
XCC=(XST-XCT(NA1))/(XCT(NA2)-XCT(NA1))
IF(XOC) 60,35,35
L35 THI=ACOS(2.*XOC-1.)

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```

HT=2.*PI-HT
CALL POINT(THETA,ACT,HT,XS,NA1,NA2,A,
CALL PGINT(THETA,ZCT,HT,ZS,NA1,NA2,A)
CONTINUE
XSAP(J)=XS
ZSAP(J)=ZS
SLOT(J)=SQRT((XSAP(J)-XSFP(J))**2+(ZSAP(J)-ZSFP(J))**2)
IF(J.LE.3) GO TO 50
IF(XSAP(J)-XSAP(J-1))50,50,45
IF(XSAP(J-1)-XSAP(J-2))50,50,60
45 CONTINUE
50 CONTINUE
60 KK=KK-1
LL=KK/15
IF(LL.LE.0) LL=1
DC 7C L=1,KK,LL
J=KK-L+1
XCCF=XSFPI(J)/CREF
ZCCF=ZSFPI(J)/CREF
XCCA=XSAP(J)/CREF
ZCCA=ZSAP(J)/CREF
GCC= SLOI(J)/CREF
WRITE(1,1004) XJCF,ZOCF,XOCA,ZOCA,GOC
1004 FORMAT(25X,5F15.7)
70 CONTINUE
CALL LSC(SLCT,XSFP,4,KK,B)
DC 80 J=1,5
80 CK(J,I,1)=B(J)
CALL LSC(SLOT,XSAP,4,KK,B)
DC 9C J=1,5
90 CK(J,I,2)=B(J)
XIS(I,1)=XSFP(KK)
XIS(I,2)=XSAP(KK)
XFS(I,1)=XSFP(1)
XFS(I,2)=XSAP(1)
100 CONTINUE
RETURN
END

```

```

      SLBRCUTINE VCVBT(IERR,IFLAG)
      CWMCN NXLOTH(4,2),NXUP1H(4,2),C(4),XCT(165),ZCI(165),THETA(165),
      LS(165),XPCI(165),ZPCT(165),NC,TITLE(8),ALFA,FSMCH,V0V(165),
      ZVT(165),CP(165),GV(165),XSTAG(4),ZTAG(4),ISTAG(4),SSTAG(4),
      3LTRAN(4,2),XTKAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,IPLOT,
      4CFL(165),DLTAS(165),CREF,THCK(165),GVBT(165),VVBT(165),
      5DLIASP(165),GVBD(165),VVBD(165),GVBDP(165),VVBDP(165),CN(4,10),
      6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2)
      7,ISLET(3)
      DIMENSION XIJ(65),THJ(65),ZIJ(65),XTCJ(64),ZTCJ(64),
      1DZDX(64),VNT(165),VNT(65,65),GVB(65),A(4),VNTJ(65),THJP(65)
      CWMCN/INTG/I1,I2,I3,I4
      REAL I1,I2,I3,I4
      DOUBLE PRECISION A
      DOUBLE PRECISION SLM,AL,A2
      IT=7
      DX=0.25
      XSM=0.
      CX=-C*OC1
      DX0=C*25
      H=0.0025
      N=32
      IERR=0
      PI=3.1415927
      NAN=2*N
      NN=2*N+1
      NB=1
      DC 10 I=1,NN
      THJ(I)=((I-1)*PI)/N
      THJP(I)=THJ(I)
      XIJ(I)=0.5*(1.+CCS(THJ(I)))
      IF(IFLAG)LC,10,5
      XTJ(I)=(1.+DX0)*XTJ(I)
      IF(XTJ(I)-1.0)7,7,6
      THJP(I)=0.
      NB=NB+1
      GC 10 10
      7  THJP(I)=ACGS(2.*XTJ(I)-1.)
      IF(N+I-1)8,10,10
      8  THJP(I)=2.*PI-THJP(I)
      10  CENTINE
      DC 20 K=1,NC

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```

NBA=(NB+1)/2
NBB=NN-(NB-1)/2
N1=NXLUTd(K,1)
N2=NXUPTH(K,2)
XE=(1.0+COS(THJP(NBA)))/2.0
DX=CX0+(1.-XE)
N1=NXLUTH(K,1)
N2=NXUPTH(K,2)
IF(IFLAG)15,16,15
CALL THICK(THJP,NBA,NBB,N1,N2,C0)
CALL THICK(THJP,NBA+1,NBB-1,N1,N2,Z1)
Z1P=((C0-Z1)*2.0)/(C(K)*(COS(THJP(NBA))-COS(THJP(NBA+1))))
C l=ZIP
CC=CO/C(K)
IF(CC-H)12,12,18
CONTINUE
IF(CI-CX)13,13,12
NEA=NBA+1
NEB=NBB-1
GC TO 11
CONTINUE
C2=(C0-H+C1*DX)/(C0-H)/DX
XSM=(C2*DX-1.)/C2
IF(XSM)200,201,202
XSM=C.
GC TC 2C1
IF(XSM-DX)201,201,2C3
203 XSM=EX
204 ZSM=I+(C0-H)*(1.-XSM/DX)*EXP(C2*XSM)
16 CONTINUE
EFS=C.0
PI4=-1./(4.*PI)
FACT=0.5/C(K)
JC=1
DO 30 J=1,NN
JJ=NN-(J-1)
IF(IFLAG)21,22,21
CALL THICK(THJP,J,JJ,NI,N2,Z1)
Z1=2.*Z1
GC TC 2
22 CALL POINTHETA,THCK,THJP(J),Z1,NI,N2,A)
CALL PCINT(THETA,THCK,THJP(JJ),Z2,NI,N2,A)
Z1=AES(Z2-Z1)

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```

23      CONTINUE
      IF(THJP(J)-PI)40,45,50
45      ZIJ(J)=C.
      GC TO 6C
40      ZIJ(J)=-FACT*Z1
      GC TO 6C
112600000
112700000
112800000
112900000
113000000
113100000
113200000
113300000
113400000
113500000
113600000
113700000
113800000
113900000
114000000
114100000
114200000
114300000
114400000
114500000
114600000
114700000
114800000
114900000
115000000
115100000
115200000
115300000
115400000
115500000
115600000
115700000
115800000
115900000
116000000
116100000
116200000
116300000
116400000
116500000
116600000
116700000
116800000

      ZIJ(J)=FACT*Z1
6C      IF(IFLAG)62,62,61
61      IF(XIJ(J)-XE)62,62,63
63      XS=XIJ(J)-XE
      ZIJ(J)=HH+(CO-H)*(1.-XS/DX)*EXP(C2*XS)
      IF(XS-XSM)205,205,204
      ZIJ(J)=ZSM
205      CONTINUE
      IF(THJ(J)-PI)64,62,62
64      ZIJ(J)=-ZIJ(J)
62      CONTINUE
      IF(J.EQ.1) HH=ABS(ZIJ(J))
      ZIJ(J)=ZIJ(J)-SIGN(1.0,ZIJ(J))*XTJ(J)*HH/(1.0+DX0)
      ZIJ(J)=0.
      ZIJ(NN)=0.
      IF(J.EQ.1) GO TO 7C
      XTCJ(JC)=(XTJ(J)+XTJ(J-1))/2.
      ZTCJ(JC)=(ZTJ(J)+ZTJ(J-1))/2.
      DZDX(JC)=(ZTJ(J)-ZTJ(J-1))/(XTJ(J)-XTJ(J-1))
      VRTJ(JC)=-(XTJ(J-1)-XTJ(J))/ABSL(XTJ(J-1)-XTJ(J)))
      /SCRT(1.0,C+EZDX(JC)**2)
      VNTJ(JC)=-VNTJ(JC)*EZDX(JC)
      JC=JC+1
70      VNTI(J)=0.0
      VNI(J)=0.0
      DC 8C I=1,NN
      VNI(I,J)=0.0
      80      CONTINUE
      30      DG 90 I=1,NN
      DC 9C J=2,NN
      CALL INFLU(XTCJ(I),ZTCJ(I),XTJ(J-1),ZIJ(J-1),XTJ(J),ZIJ(J))
      VNTI(I,J-1)=VNTI(I)*I1+VNTI(I,J-1)-VNTJ(I)*I3
      VNT(I,J)=VNTI(I)*I2-VNTJ(I)*I4
      EFS=EPS+ABS(VNT(I,J-1))
      EFS=(EPS*1.0E-20)/4225.
      VNT(NN,I)=1.0
      VNI(NN,NN)=1.0

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```

1C0   DC 130 I=1,N
      VNI(I,NN)=PI4
      PI4=-PI4
      J=N+1
      DC 110 I=J,NN
      VNI(I,J)=PI4
      PI4=-PI4
      CALL GJRV(VNI,NN, C5,EPS,L)
      IF(L.EQ.0) GO TO 120
      IERR=-1
      WRITE(11,1000)
      1000 FORMAT(44HCMATRIX INVERSION FAILED IN SUBROUTINE VOVBI)
      RETURN
C
12C   DC 121 I=1,NN
      SLM=C*0
      DC 120 J=1,NN
      A1=VNT(I,J)
      A2=VNT(I,J)
      130  SLN=SUM+A1*A2
      GVBI(I)=SUM
      121  CCNTINUE
      ND=NB-1
      NEB=1+ND/2
      NE=NN-ND/2
      DC 140 I=N1, N2
      CALL POINT(IHJP,GVB,THETA(I),GVBD(I),NBB,NE,A)
140  VVBD(I)=ABS(GVBD(I))
      VVBD(N1)=(VVBD(N1+1)+VVBD(N2-1))/2.
      VVBD(N2)=VVBD(N1)
      GVBC(N1)=SIGN(VVBD(N1),GVBD(N1+1))
      GVBL(N2)=SIGN(VVBD(N2),GVBD(N2-1))
      IF(IFLAG).GT.150,15C,20
      150  DC 160 I=N1, N2
            GVBI(I)=GVBC(I)
            VVBI(I)=VVBD(I)
      160  CCNTINUE
      DC 180 I=N1, N2
      DLIASP(I)=CLIAS(I)
      RETURN
      END
      120900000

```

```

SUBROUTINE THICK(THJP,J1,J2,N1,N2,Z)
CCMPCN NXLOTH(4,2),NXUPTH(4,2),C(4),XCT(165),ZCT(165),THETA(165),
1S(165),XPC(165),ZPCT(165),NC,TITLE(8),ALFA,FSMCH,VOV(165),
2VI(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),TSTAG(4),SSTAG(4),
3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,IPLOT,
4CFI(165),DLIAS(165),CREF,THCK(165),GVBT(165),VVBBI(165),
5DLIASP(165),GVBD(165),VVBC(165),VVBDP(165),CN(4,10),
6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2),
7,ISLCT(3)

DOUBLE PRECISION A(4)
DIMENSION THJP(65)
CALL POINT(THETA,THCK,THJP(J1),Z1,N1,N2,A)
CALL POINT(THETA,THCK,THJP(J2),Z2,N1,N2,A)
ZI=(Z2-Z1)/2.
IF(THJP(J1)-3.1415927) 2,2,1
ZI=-ZI
CONTINUE
1 CALL POINT(THETA,DLIAS,THJP(J1),ZB1,N1,N2,A)
2 CALL POINT(THETA,GLIAS,THJP(J2),ZB2,N1,N2,A)
ZC=ZI+ZB2
CALL POINT(THETA,GLIASP,THJP(J1),ZB3,N1,N2,A)
CALL POINT(THETA,GLIASP,THJP(J2),ZB4,N1,N2,A)
ZUP=(ZB3+ZB4)/2.0
Z=ZI+(ZE+ZCP)/3.0
RETURN
END

```

```

SUBROUTINE INFLU (XC,ZC,X1,Z1,X2,Z2)
C
C      ROUTINE TO COMPUTE THE INFLUENCE OF A LINEAR VORTEX SHEET
C
C      CALLING SEQUENCE.....
C      CALL INFLU (XC,ZC,X1,Z1,X2,Z2)
C      XC AND ZC ARE THE JORDINATES OF THE POINT AT WHICH THE
C      INFLUENCE OF THE VORTEX SHEET IS TO BE EVALUATED,
C      (X1,Z1) AND (X2,Z2) DEFINE THE END POINTS OF THE VORTEX
C      SHEET
C
C      *NOTE THE RESULTS OF THIS ROUTINE ARE TRANSFERRED BY
C      COMMNCN/INTG/
C
C      COMMNCN/INTG/ 11,12,13,14
C      REAL L,II,III,11,12,13,14
C      DATA PI/3.1415927/
C      L=SQRT((X2-X1)**2+(Z2-Z1)**2)
C      A=(X(-X1)**2+(ZC-Z1)**2
C      B=-2.0/L*((XC-X1)*(X2-X1)+(ZC-Z1)*(Z2-Z1))
C      Q=4.*A-B**2
C      F=ALOG((A+B*L+L**2)/A)
C
C      IS THE PCINT (XC,ZC) COLINEAR WITH THE VORTEX SHEET, IF SC
C      C=0
C
C      IF (C) 10,10,40
C
C      IF C=0, DOES THE POINT (XC,ZC) LIE ON THE VORTEX SHEET, IF SO
C      GO TO 60
C
C      10 11=A/L**2
C          IF ((11-1.0) 30,30,20
C      20 G=(2.*L)/(2.*A+B*L)
C      GC TO 5C
C      30 11=R1+B/L
C          IF ((11) 60,60,20
C      40 Y=L*SCRT(Q)
C          X=2.*A+B*B
C          XABS=X/ABS(X)

```

```

YABS=Y/ABS(Y)
G=2.*SQR((C)*(PI/2.*(-XABS)*YAJS+XABS*YAJS*ATAN(ABS(Y/X))) )
5C
I1=(F-B*S)/2.
I11=L+((B**2-2.*A)*G-B*F)/2.
I=1.C/(2.0*PI*L)
C
C   I1 AND I3 ARE THE VELOCITY COMPONENTS DUE TO GAMMA-1
C   I2 AND I4 ARE THE VELOCITY COMPONENTS DUE TO GAMMA-2
C
I1=I*((ZC-Z1)*L*G-(Z2+ZC-2.*Z1)*II+(Z2-Z1)/L*III)
I2=I*((ZC-Z1)*II-(Z2-Z1)/L*III)
I3=I*((XC-X1)*L*G-(X2+XC-2.*X1)*II+(X2-X1)/L*III)
I4=I*((XC-X1)*II-(X2-X1)/L*III)
RETURN
6C  SC=SQRT((XC-X1)**2+(ZC-Z1)**2)
I1=4.*PI*L**2
I1=-II
I2=(F*(L-SC)-2.*L)/II
I3=(F*SC+2.*L)/II
I1=I2*(Z2-Z1)
I2=I3*(Z2-Z1)
I3=I2*(X2-X1)
I4=I2*(X2-X1)
RETURN
END

```

```

SUBROUTINE MAIN2(IERR,IPFLAG,K,XPP,ZPP)
COMMON NXLCI(4,2),NXUPT(4,2),C(4),XCT(165),ZCT(165),THETA(165),
1S(165),XPCI(165),ZPC(165),NC,TITLE(8),ALFA,FSMCH,VQV(165),
2VT(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),ISTAG(4),SSTAG(4),
3LT(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,IPLOT,
4CH(165),DLTASS(165),CREF,THICK(165),GVBT(165),VVBT(165),
5DLTASP(165),GVBD(165),VVBDP(165),GVBDP(165),CN(4,10),
6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2),
7,ISLET(3)

DIMENSION NXLCP(4,2),NXUCP(4,2),XCP(165),ZCP(165),DZDXCP(165),
1TCP(165),XPP(112),ZPP(112)
DIMENSION BSEG(2)
DATA LFILE/3HLCG/
IERR=0

IT=7
BSEG(1)=4HSEG3
BSEG(2)=0
CALL SEGMENT(LFILE,2,BSEG,0,MAP)
CALL EQUIV
CALL CGNTPT(NXLCP,NXUCP,XCP,ZCP,DZDXCP,TCP)
BSEG(1)=4HSEG4
BSEG(2)=0
CALL SEGMENT(LFILE,2,BSEG,0,MAP)
CALL COEFF(EPS,NXLCP,NXUCP,XCP,ZCP,DZDXCP,TCP)
NPTS=NXUCP(NC,2)+NC
CALL VORTEX(IERR,EPS,NPTS,XCP,ZCP,DZDXCP)
IF(IERR)40,30,40
30 BSEG(1)=4HSEG5
BSEG(2)=0
CALL SEGMENT(LFILE,2,BSEG,0,MAP)
XN=FSMCH
IF((K.EQ.1).OR.(NC.EQ.1)) GO TO 35
33 IFLAG=L
CALL VOVBT(IERR,IPFLAG)
IF(IERR)40,50,40
50 CCNTINUE
F1=1.
IF(K.EQ.2) F1=2./3.
DC 6C I=1,NPTS
GV(I)=GV(I)+(2.*GVBE(I)+GVBDP(I))/3.-GVBT(I)*F1
VI(I)=ABS(GV(I))
DC 7C I=1,NPTS

```

6V8CF(1)=GV8D(1)
VV8CF(1)=VV8D(1)
35 COUNTINE
DL 45 I=1,NPTS
45 DLIASP(1)=CLTAS(L)
CALL CCPMR(NPTS,IPFLAG,XM,K)
CALL STAG
4C RETURN
END

134500000
134600000
134700000
134800000
134900000
135000000
135100000
135200000
135300000

```

SUBROUTINE EQUIV
C
COMMON NXLCTH(4,2),NXUPTH(4,2),C(4),XC1(165),ZCT(165),THETA(165),
      XPC(165),ZPCT(165),NC,TITLE18,ALFA,FSMCH,VUV(165),
      2VT(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),SSTAG(4),
      ZLTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PC,TO,RN,PR,KF,NCU,IPLOT,
      4CFI(165),ULTAS(165),CREF,THCK(165),GVBT(165),VBT(165),
      SDLTASP(165),GVBC(165),VVBD(165),VVBDP(165),CN(4,10),
      EMAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2)
      7• ISLCT(3)
      DC 10 I=1,NC
      NI=NXL0TH(1,1)
      N2=NXUPTH(1,2)
      N2=NXL0TH(1,2)
      DC 20 K=1,2
      CALL SMOOTH(THETA(N1),DLTAS(N1),N2-N1+1)
      2C  CCNTINUE
      DA=AIAN((ZCT(N1)+ZCI(N2)-2.*ZCT(N3))/(XCT(N1)+XCT(N2)-2.*XCT(N3)))
      SIND=SIN(DA)
      CCSD=COS(DA)
      DC 10 J=N1,N2
      JJ=N2-(J-N1)
      DZC=2./3.* (DLTAS(JJ)-DLTAS(J))+ (DLTASP(JJ)-DLTASP(J))/3.
      IF ((JJ-J)3C,40,40
      30   DZC=-DZC
      40   CCNTINUE
      XPC(J)=XCT(J)-DZC*SIND
      ZFCT(J)=ZCT(J)+DZC*COSD
      10   CCNTINUE
      RETURN
      END

```

```

SUBROUTINE SMOOTH(Λ, Y, N)
DIMENSION X(1), Y(1)
SF=C.5
IF(N.LE.3) RETURN
A=0.
B=C.
NE=N-3
DC 3C J=1,NE
AP=A
BP=B
SX=0.
SY=C.
SX=Y=C.
SX2=C.
J2=J+3
DC 20 I=J,J3
SX=SX+X(I)
SY=SY+Y(I)
SX=Y+SXY+X(I)*Y(I)
SX2=SX2+X(I)**2
20 A=(SX*SXY-SX2*SY)/(SX*SX-4.*SX2)
B=(SX*SY-4.*SXY)/(SX*SX-4.*SX2)
IF(J*NE.1) GO TO 1C
Y(J+1)=(I.-SF)*Y(J+1)+SF*(A+B*X(J+1))
GC TC 30
Y(J+1)=(I.-SF)*Y(J+1)+SF*(A+AP+(B+BP)*X(J+1))/2.
30 CCNTINUE
Y(N-1)=(I.-SF)*Y(N-1)+SF*(A+B*X(N-1))
RETFLN
END

```

```

C      SUBROUTINE CCN1PT (NXLCP,NXUCP,XCP,ZCP,DZDXCP,TCP)
C      . . . . .
C      . . . . . ROUTINE TO COMPUTE THE CONTROL POINT ORDINATES AND SLOPES
C      . . . . .
C      . . . . . CALL CUNPT (NXLCP,NXUCP,XCP,ZCP,DZDXCP,TCP)
C      . . . . . NXLCP AND NXUCP ARE THE CONTROL POINT INDEX ARRAYS,
C      . . . . . XCP AND ZCP ARE THE CONTROL POINT ORDINATES.
C      . . . . . DZDXCP IS THE SURFACE SLOPE AT THE CONTROL POINT, TCP IS
C      . . . . . ANGLE EQUIVALENT OF XCP
C      . . . . .
C      *NOTE    THE COMMON BLOCK ARRAYS USED IN THIS ROUTINE ARE
C              NXLDTH,NXUPTH,XXCT, AND ZZCT
C      . . . . .
C      . . . . . CCN1CN NXLOTH(4,2),NXUPTH(4,2),C(4),XCT(165),ZCT(165),THETA(165),
C      . . . . . IS(165),XPCT(165),ZPCT(165),NC,TITLE(8),ALFA,FSMCH,V0V(165),
C      . . . . . 2VT(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),SSTAG(4),
C      . . . . . 3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NGU,IPLOT,
C      . . . . . 4CF(165),DLTAS(165),CREF,THCK(165),GVBT(165),VBFT(165),
C      . . . . . SDLTASP(165),GVBD(165),VVBD(165),GVBDP(165),VVBDP(165),CN(4,10),
C      . . . . . 6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2)
C      . . . . . 7,ISLCT(3)
C      . . . . . DIMENSION NXLCP(4,2),NXUCP(4,2),XCP(165),ZCP(165),DZDXCP(165),
C      . . . . . IICP(165)
C      . . . . . DATA PI/3.1415927/
C      . . . . . K=0
C      . . . . . DC 50 I=1,NC
C      . . . . .
C      . . . . . STORE THE INDEX OF THE FIRST POINT ON THE LOWER SURFACE
C      . . . . .
C      . . . . . NXLCF(I,1)=K+1
C      . . . . . N1=NXLTH(I,1)
C      . . . . . N2=NXUPTH(I,2)
C      . . . . . N3=NXLTH(I,2)
C      . . . . . NI=NI+1
C      . . . . . DC 40 J=NI,N2
C      . . . . .
C      . . . . . FIND THE CONTROL POINT ORDINATES
C      . . . . .
C      . . . . . K=K+1

```

```

1C TCP(K)=ACOS((CCS(THETA(J-1))+COS(THETA(J)))/2.)
IF (PI-THETA(J)) 10,20,20
1C TCP(K)=2.*PI-TCP(K)
2C XCP(K)=(XPC(J)+XPC(J-1))/2.
ZCP(K)=(ZPC(J)+ZPC(J-1))/2.
LZDXCP(K)=(ZPC(J)-ZPC(J-1))/(XPC(J)-XPC(J-1))
IF (J-NXLGH(1,2)) 40,30,40
C REACTED INDEX OF NCSE POINT. STORE SUBSCRIPTS.
C
3C NXLCP(I,2)=K
NXUCP(I,1)=K+1
4C CONTINUE
NXLCP(I,2)=K
N1=NXLCP(I,1)
50 CONTINUE
REILFN
END

```

```
      SUBROUTINE COEFF (EFS,NXLCP,NXUCP,XCP,ZCP,DZDXCP,TCP)
      C      CALL COEFF (EPS,NXLCP,NXUCP,XCP,ZCP,DZDXCP,TCP)
      C      EFS IS THE SINGULARITY CHECK CONSTANT TO BE USED IN VORTEX,
      C      NXLCP AND NXUCP ARE THE CONTROL POINT INDEX ARRAYS,
      C      XCP AND ZCP ARE THE CONTROL POINT COORDINATES, DZDXCP IS
      C      THE SURFACE SLOPE AT THE CONTROL POINT, TCP IS THE ANGLE
      C      EQUIVALENT OF XCP
      C
      C      CALL SEQUENCE.....
      C      *NOTE      THE COMMON BLOCK ARRAYS USED IN THIS ROUTINE ARE
      C      NXUPTH, XPCF, AND ZPCF
      C      THE OUTPUT OF THIS ROUTINE IS TRANSFERRED BY
      C      COMMON/VNM/
      C
      C      COMMON NXLCTH(4,2),NXUPTH(4,2),C(4),XCT(165),ZCT(165),THETA(165),
      C      LS(165),XPCF(165),ZPCT(165),NC,TITLE(8),ALFA,FSMCH,V0V(165),
      C      2VR(165),GP(165),GV(165),XSTAG(4),ZSTAG(4),TSSTAG(4),
      C      3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,IPLOT,
      C      4CFI(165),DLTAS(165),CREF,THCK(165),GVBT(165),VVB(165),
      C      SDLTASP(165),GVBL(165),VVB(165),GVBDP(165),CN(4,10),
      C      6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2)
      C      7,ISLCT(3)
      C      DIMENSION NXLCP(4,2),NXUCP(4,2),XCP(165),ZCP(165),DZDXCP(165),
      ITCP(165)
      COMMON/VNM/VN(165,165),VN(165)
      COMMON/INTG/ I1,I2,I3,I4
      REAL I1,I2,I3,I4
      DATA PI/3.1415927/
      EPS=C.0
      SIN=SIN(ALFA)
      CCSA=COS(ALFA)
      NPIS=NXLCP(NC,2)
      C
      C      INITIALIZE THE VN AND VNV ARRAYS
      C
      DC 10 I=1,165
      VN(I)=C.0
      1512C0000
      1513C0000
      1514C0000
      1515C000
      1474C0000
      1475C000
      1476C000
      1477C000
      1478C000
      1479C000
      1480C000
      1481C000
      1482C000
      1483C000
      1484C000
      1485C000
      1486C000
      1487C000
      1488C000
      1489C000
      1490C000
      1491C000
      1492C000
      1493C000
      1494C000
      1495C000
      1496C000
      1497C000
      1498C000
      1499C000
      1500C000
      1501C000
      1502C000
      1503C000
      1504C000
      1505C000
      1506C000
      1507C000
      1508C000
      1509C000
      1510C000
      1511C000
      1512C000
      1513C000
      1514C000
      1515C000
```

```

      DC IC J=1,165
      VN(I,J)=0.0
      IC=1
      DC 5C I=1,NPTS
      JC=1
      K=I+IC-1
      152100000
      152200000
      152300000
      152400000
      152500000
      152600000
      152700000
      152800000
      152900000
      153000000
      153100000
      153200000
      153300000
      153400000
      153500000
      153600000
      153700000
      153800000
      153900000
      154000000
      154100000
      154200000
      154300000
      154400000
      154500000
      154600000
      154700000
      154800000
      154900000
      155000000
      155100000
      155200000
      155300000
      155400000
      155500000
      155600000
      155700000
      155800000

C   XNI AND XNJ ARE THE X AND Z COMPONENTS OF THE UNIT VECTOR,
C   NORMAL TO THE SURFACE AT THE CONTROL POINT
C
C   XNI=(XPCT(K)-XPCT(K+1))/ABS(XPCT(K)-XPCT(K+1))/SQRT(1.0+DZDXCP(I
C   1**2))
C
C   XNJ=-XNI
C   XNI=TZDXCP(I)*XNI
C
C   VN(I,J) IS THE COMPONENT OF THE FREE STREAM VELOCITY NORMAL TO THE
C   SURFACE AT THE CONTROL POINT
C
C   VN(I,J)=COSA*XNI+SINA*XNJ
C
C   VN(I,J) IS THE INFLUENCE OF THE J-TH VORTEX ON THE NORMAL
C   VELOCITY AT THE I-TH CONTROL POINT
C
DC 30 J=1,NPTS
      M=J+JC-1
      CALL INFLU (XCP(I),ZCP(I),XPCT(M),ZPCT(M),VN(I,M)
      VN(I,M)=XNI*I1-XN1*I3+VN(I,M)
      VN(I,M+1)=XNI*I2-XN1*I4
      EPS=EPS+ABS(VN(I,M))
      IF I(M+1)-NXUPTH(JC,2) 30,20,20
      2C JC=JC+1
      3C CONTINUE
      IF ((K+1)-NXUPTH(IC,2)) 50,40,40
      4C IC=IC+1
      5C CONTINUE

C   EPS IS THE MEAN MAGNITUDE OF THE INFLUENCE COEFFICIENTS TIMES
C   10.**(-20)
C
C   EPS=EPS/(NPTS*NPTS)*1.0E-20
C
C   SET UP THE KUTTA-CONDITION AND LIMIT FACTOR
C

```

```

DC 8C K=1,NC
L1=NXLCP(K,1)+K-1
L2=NXLCP(K,2)+K
J1=NPI S+K
N1=L1-K+1
N2=(L1+L2)/2-K
N3=L2-K
DC 6C J=N1,N2
6C VN(J,L2)=-1./((4.*PI))
N2=N2+1
DC 7C J=N2,N3
7C VN(J,L1)=1./((4.*PI))
VN(J1+L1)=1.
8C VN(J1+L2)=1.
RETURN
END

```

1559C0000
1560C0000
156100000
1562C0000
156300000
156400000
156500000
1566C0000
1567C0000
156800000
156900000
157000000
1571C0000
157200000
157300000
1574C0000

```

SUBROUTINE VORTEX(IEPS,EPS,NPTS,XCP,ZCP,DZDXCP)
CCMNCN NXLCTH(4,2),NXUPTH(4,2),C(4),XCT(165),ZCT(165),THETA(165),
IS(165),XPCT(165),ZPCT(165),NC,TITLE(8),ALFA,FSMCH,VUV(165),
ZVT(165),CP(165),EV(165),XSTAG(4),ZSTAG(4),ISTAG(4),SSTAG(4),
BLIRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,IO,RN,PR,KF,NCU,IPLUT,
4CF(165),DLTAS(165),CREF,THCK(165),GVBT(165),VVB(165),
5DLTASP(165),GVBD(165),GVBDP(165),VVBDP(165),VVBOP(165),CN(4,10),
6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2)

7. ISLCI(3)
      CCMNCN/INTG/I1,I2,I3,I4
      CCMNCN/VNM/VN(165,165),VN(165)
REAL I1,I2,I3,I4
DOUBLE PRECISION SUM,A,B
DIMENSION XCP(165),ZCP(165),DZDXCP(165)
PI=3.1415927
IERR=0
IT=7

      CALL GJRV(VN,NPTS,165,EPSS,L)
      IF(L.EQ.0) GO TO 10
      IERR=-1
      WRITE(IT,100)
      1000
      1CCC FORMAT(45HOMATRIX INVERSION FAILED IN SUBROUTINE VORTEX)
      RETURN

C      10 DC 3C I=1,NPTS
      SUM=C.
      DC 20 J=1,NPTS
      A=VN(1,J)
      B=VN(1,J)
      20 SUM=SUM+A*B
      GV(1)=SUM
      30 CCNTINUE
      DC 40 J=1,NPTS
      VT(J)=ABS(GV(J))
      40 CCNTINUE
      DC 50 I=1,NC
      NL=NXLCTH(I,1)
      NL=NXUPTH(I,2)
      VT(NL)=(VT(NL+1)+VT(NL-1))/2.
      VT(NU)=VT(NL)
      GV(NL)=SIGN(VT(NL),GV(NL+1))


```

5C GV(NL)=SIGN(VT(NL),GV(NU-1))
 RETN
 END

16170000
16180000
16190000

```

SUBROUTINE CCMPLR (NPTS, IPFLAG, XM, IN)
COMMON NXPLTH(4,2),NXUPTH(4,2),C(4),XCII(165),ZCII(165),THEFA(165),
1S(165),XPCT(165),ZPCT(165),NC,TITLE(8),ALFA,FSMCH,VOV(165),
2VT(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),TSTAG(4),SSTAG(4),
3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,KN,PR,KF,NCU,IPLUT,
4CFII(165),OLIAS(165),CREF,THCK(165),GVDT(165),VVB(165),
5DLIASP(165),GVBL(165),VVBDC(165),GVBDP(165),VN(4,10),
6MAP,CK(5,3,2),XIS(2,2),XFSI(3,2),FF(3,2),
7,ISLCT(2)
CCMN CN/SLDI/ MLS(165)
DIMENSION XOC(165),ZOC(165),CC(5)
REAL ML,MLS
DOUBLE PRECISION A(4)
DIMENSION PLSEG(2)
DATA GAMMA/1.4*,PI/2.1415927/
DATA IUP,ILO/5HUPPER,5HLOWER/,LFILE/3HFILE/
DATA IBK,INN/2H ,2+IN/
M=6
JN=IN-1
MLS=5.
XL=XM**2/(1.+SQRT(1.-XM**2))**2
DC 30 I=1,NPTS
VCV(I)=VT(I)*(1.-XL)/(1.-XL*VT(I)**2)
IF((VCV(I))<1.,2,2
VCV(I)=0.
CONTINUE
IF(XM) 6,6,3
3 VCVS=MLS/XM*SQRT((1.+(GAMMA-1.)/2.*XM*XN)/(1.+(GAMMA-1.)*
1/2.*MLS*MLS))
IF((VCV(I)-VCVS)<6,6,5
5 VCV(I)=VCVS
MLS=MLS+0.1
CONTINUE
I=1.+(GAMMA-1.)/2.*XM**2*(1.-VOV(I)**2)
MLS=(XM*VOV(I))/SQRT(I)
IF(XM) 20,10,20
1C CP(I)=1.-VCV(I)**2
GC TO 30
20 CP(I)=2.+(GAMMA*XM**2)*(T**2*(GAMMA/(GAMMA-1.))-1.)
30 CONTINUE
NCI=NC-1

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```

IF(NC1.LE.C)GC 10 28
DC 25 I=1,NC1
IF( ISLT(I).LE.0) GC TO 35
NS=1
J=1
N1=NXLOTH(NS,1)
N2=NXLOTH(NS,2)
N3=NXUPTH(NS,2)
IF(XCT(N2)-XCT(N2-1))23,24,25
N2=N2-1
25
GC TC 22
23 IF(XCT(N2)-XCT(N2+1))24,24,26
N2=N2+1
26
GC TO 23
24
CONTINUE
XND=(XIS(I,J)-XCT(N2))/(XCT(N1)-XCT(N2))
XND=ABS(XND)
THET=ACOS(2.*XND-1.)
IF(J.EQ.2) THET=THET+PI
CALL POINT(theta,ML,THET,SML,N1,N3,A)
DC 22 K=1,5
32 CC(K)=CK(K,I,J)
CALL SLCTFL(FF(I,J)*SML,XIS(I,J),XFS(I,J),CC,N1,N2,N3,J)
35
CONTINUE
38
CONTINUE
IF(IFFLAG.GT.0)GO TC 80
C
C PRINT SECTION
IFLAG=7
ALF=ALFA*57.2957795
LINES=6C
IIN=IBK
IF(IN.EQ.1) IIN=INN
DC 70 I=1,NC
IS=ILC
N1=NXLUTH(I,1)
N2=NXLOTH(I,2)
DC 70 K=1,2
DC 6C J=N1+N2
IF(LINES-56)50,4C,4C
4C WRITE(M,1000) IIN,TITLE,XM,ALF,IS,I,JN
LINES=10
5C LINES=LINES+1

```

```

XCC(J)=XCT(J)/CREF
ZCC(J)=ZCT(J)/CREF
      WRITE(M,LOC1) XCC(J),ZOC(J),VT(J),VUV(J),ML(J),CP(J)
IS=IUP
N1=NXUPTH(I,1)
N2=NXUPTH(I,2)
LINES=60
7C CONTINUE
ICCC FORMAT(1H1,25X,A2,20HVISCID FLOW SOLUTION,1J,25X,8A10,1J,25X,
12HMACH NUMBER=F7.5,25X,16HANDLE OF ATTACK=F7.3,2X,4HDEG.,1J,
210X,A,7HSURFACE/1C7X,16HCOMPONENT NUMBER,I3//,
21C7X,16ITERATION NUMBER,I3//,
310X,1HX+19X,1HZ,15X,10H(V/VG)INC.,10X,12H(V/VG)CUMPR.,12X,2HML,
416X,ZHCP//)
ICCI FORMAT(4X,6(F12.5,8X))
C CHECK FOR PLOTS
C IF(IFLCT.LE.0) GO TO 80
C PLSEG(1)=4FSEC4
C PLSEG(2)=0
C CALL SEGMENT(ULFILE,2,PLSEG,0,MAP)
C CALL PLCTCF(XCT,CP,NXUPTH,NXLTH,FSMCH,ALF,ITLE,NC,CREF)
C CALL DC 9C I=1,NPTS
90 VCV(I)=NL(I)
RETFN
END

```

```

SUBROUTINE SLUTFL(F,SM1,XIN,XF,C,N1,N2,N3,JS)
CCMN CN XLCTH(4,2),NXUPTH(4,2),C(4),XCT(165),ZCT(165),THEIA(165),
IS(165),XPCT(165),LPCT(165),NC,TITLE(8),ALFA,FSMCH,VGV(165),
2V(165),CP(165),XSTAG(4),ZSTAG(4),ISTAG(4),SSTAG(4),
3LTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,IPLGT,
4CFI(165),CLFAS(165),CREF,THCK(165),GVBT(165),VVBT(165),
5DLIASP(165),GVBC(165),VVBDP(165),VVBDP(165),CN(4,10),
6MAP,CK(5,3,2),XIS(3,2),XF(3,2),FF(3,2),
7,ISLCI(3),
DIMENSION X(51),H(51),HP(51),Y(51),C(51),SLOTM(51),TH(51),
1,CPP(51),
CCMN/SLUT/ ML(165)

REAL ML
DOUBLE PRECISION A(4)
DATA PI/3.1415927/
FSM=FSMCH
XL=FSM**2/(1.+SGRT((1.-FSM**2))**2
M AND CP FCR SLOT FLOW
ERAC=(1.0+2*FSM**2)/(1.0+2*SM1**2)
CPI=2.0/(1.4*FSM**2)*(BRAC**3.5-1.0)
CF1=1.43*CP1-0.53
SN1=SQRT((1.+0.2*FSM**2)/(1.+0.7*CP1*FSM**2)*0.286-5.0)
BRAC=(1.0+C.2*FSM**2)/(1.0+0.2*SM1**2)
DELX=(XF-XIN)/50.
NP=5
INTERPOLATE
X(1)=XIN
DC 1CO I=1,NP
H(I)=C(5)*X(I)**4+C(4)*X(I)**3+C(3)*X(I)**2+C(2)*X(I)+C(1)
HF(I)=4.*C(5)*X(I)**3+3.*C(4)*X(I)**2+2.*C(3)*X(I)+C(2)
HPP(I)=12.*C(5)*X(I)**2+6.0*C(4)*X(I)+2.0*C(3)
X(I+1)=X(I)+DELX
XCC=(X(I)-XCT(N2))/(XCT(N1)-XCT(N2))
XCC=ABS(XCC)
TH(I)=ACOS(2.*XCC-1.)
IF(JS.EQ.2) TH(I)=2.*PI-TH(I)
CCNLINE
1CC
Y(1)=SM1**2
NF1=NP-1
DC 1C2 I=1, NP1
CALL YDERS(Y(I),YP,YPP,H(I),HP(I),HPP(I),F)

```

```

Y(I+1)=Y(I)+YP*DELx+YP*DELx**2/2.0
1C2
CCNTINUE
DC 2CC I=1,NP
IF(I-1) 31C,31C,31I
310 SLCIN(I)=SN1
CFP(I)=CP1
GC TU 312
311 SLCIN(I)=SQRT(Y(I))
CFP(I)=2./((1.4*FSM**2)*((1.+0.2*FSM**2)/(1.+0.2*Y(I))**3.5-1.0))
312 CCNTINUE
312 CCNTINUE
2CC CCNTINUE
CALL PCINT(THETA,ML,TH(I),DUM,N1,N3,A)
NA=A(4)
IF(X(I)-XCT(NA))55,55,50
AA=NA-1
50 CCNTINUE
CALL PCINT(THETA,ML,TH(SI),DUM,N1,N3,A)
NE=A(4)
NN1=MINO(NA,NB)
NN2=MAXC(NA,NB)
IF(J<=0.2) GC 10 17
DC 12 J=1,NP
IJ=NF+1-J
HF(I,J)=TH(J)
HPP(I,J)=SLCTM(J)
DC 14 J=1,NP
TH(J)=HP(J)
SLCIN(J)=HFP(J)
13 CCNTINUE
14 CCNTINUE
17 DC 2C I=NN1,NN2
CALL PCINT(TH,SLOT,THETA(I),ML(I),1,5I,A)
VCV(I)=ML(I)/FSM*SQR((I.+0.2*FSM**2)/(1.+0.2*ML(I)**2))
I=1.+C.2*FSM**2*(1.-VOV(I)**2)
CP(I)=2./((1.4*FSM**2)*(I**3.5-1))
V(I)=SQRT(((1.-XL)/(2.*XL*VOV(I))**2+1.)/XL)-(1.-XL)/(2.*XL*)
1VCV(I)
2C CCNTINUE
RETURN
END

```

```

C          SUBROUTINE YDERS (Y,YP,YPP,H,HP,HPP,F)
C          .
C          .
C          * ROUTINE TO COMPUTE THE SQUARE OF THE LOCAL MACH NUMBER AND
C          * THE FIRST AND SECOND DERIVATIVES
C          .
C          * CALLING SEQUENCE . . . .
C          * CALL YDERS (Y,YP,YPP,H,HP,HPP)
C          * Y IS THE SQUARE OF THE LOCAL MACH NUMBER, YP AND YPP ARE
C          * THE FIRST AND SECOND DERIVATIVES OF Y WITH RESPECT TO X,
C          * H IS THE SLOT HEIGHT, HP AND HPP ARE THE FIRST AND SECOND
C          * DERIVATIVES OF F WITH RESPECT TO X, F IS THE SLOT FRICITION
C          * FACTOR
C          .
C          .
C          * TERM1=2.0*Y*((1.0+2*Y)/(1.0-Y))
C          * TERM2=1.4*Y**2*(1.0+C+2*Y)/(1.0-Y)
C          * YF==TERM1*HF/H+TERM2*2.0*F/H
C          * TERM3=HPP*Y*((2.0+4*Y)
C          * TERM4=HP*YF*((3.-2*Y)
C          * TERM5=H*YP**2
C          * TERM6=5.6*F*Y*YP
C          * TERM7=1.68*F*Y**2*YF
C          * YPP=1.0/(H*(1.0-Y))*(-TERM3-TERM4+TERM5+TERM6+TERM7)
C          RETURN
C          END

```

```

SUBROUTINE STAG
CWMCN NXLOTH(4,2),NXUPTH(4,2),C(4)*XCT(165),ZCT(165),THETA(165),
1S(165),XPCT(165),ZPCT(165),NC,TITLE(8),ALFA,FSMCH,MLI(165),
2VT(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),ISTAG(4),SSTAG(4),
3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,IPLOT,
4CF(165),DLTAS(165),CREF,THCK(165),GVBT(165),VVB(165),
5ULASP(165),GVBL(165),VVBDP(165),VVBDP(165),CN(4,10),
6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2)
7,ISLC(3)

DOUBLE PRECISION A
DIMENSION A(4),X(165),Z(165),XN(4),ZN(4),BETA(4)
DC EC I=1,NC
N1=NXLTH(1,1)
N2=NXUPH(1,2)
NF1S=N2-N1+1
N=NXLTH(1,2)
XN(1)=XCT(N)
ZN(1)=ZCT(N)
BETA(1)=ATAN((ZCT(N1)-ZCT(N))/(XCT(N1)-XCT(N)))
CALL TRANS(X(N1),Z(N1),0.,0.,XCT(N1),ZCT(N1),BETA(1),XN(1)),
12A(1),NPTS)
NB=(2*N1+N2)/4
NE=(N1+3*N2)/4
J=AB
IF(GV(J))2,1,4
1 ISTAG(I)=THETA(J)
   GC IC 70
2 J=J+1
   IF(J.GT.NE) 60 10 1
   IF(GV(J))2,1,6
3 J=J+1
   IF(J.GT.NE) 6,1,4
   IF(AES(GV(J))-AES(GV(J-1)))10,10,8
4 J=J-1
   IF(AES(GV(J))-AES(GV(J-1)))10,10,8
5 CALL POINT(THETA,GV,THETA(J),DUM,J-1,J+1,A)
   SC=DSQRT(DABS(A(2)*A(2)-4.*A(1)*A(3)))
   T1=(-A(2)+SQ)/(2.*A(3))
   T2=(-A(2)-SQ)/(2.*A(3))
   IF(AES(THETA(J)-T1)-ABS(THETA(J)-T2))50,50,60
6 ISTAG(I)=I
   GC IC 70

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```

9C 1STAG(I)=T2
7C CONTINUE
XSTAG(I)=C(I)/2.*((1.+CCS(I)STAG(I)))
CALL POINT(THEIA,Z,ISTAG(I),ZSTAG(I),J-1,J+1,A)
CALL POINT(RHETIA,S,ISTAG(I),SSTAG(I),J-1,J+1,A)
BEIA(I)=-BETA(I)
CALL TRANS(XSTAG(I),ZSTAG(I),ZN(I),XN(I),XSTAG(I),
IZSTAG(I),BETA(I),0.,0.,1)
8C CONTINUE
KETLN
END

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18800000
18810000
18820000
18830000
18840000
18850000
18860000
18870000
18880000
18890000
18900000

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SUBROUTINE MAIN(IPFLAG,HSEPF,IN,ISEP)
REAL WIEAP,AL,KF
CCMNCN NXLCIH(4,2),NXUPT(4,2),C(4),XCT(165),ZCT(165),THETA(165),
IS(165),XPCT(165),ZPCT(165),NC,TITLE(8),ALFA,FSMCH,ML(165),
2VT(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),TSTAG(4),SSTAG(4),
3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,PLUT,
4CFI(165),DLTAS(165),CREF,THCK(165),GVBT(165),VWBT(165),
5DLTASP(165),GVBDI(165),GVBDP(165),VVBDP(165),CNN(4,10),
6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2)

7* ISLC I(3)
DCUBLE PRECISION A(4)
CCMNCN /VISCONS/STEMP(65),WTEMP(65),UE(65),UEDS(65),
1DDMDS(65),XTEMP(65),ISURF,ITEMP(65),ZTEMP(65)
2,XM(65),TINF,X,XNLU
CCMNCN/TURBTR/SCRIPT,RECRIT,STRAN,KTRAN,THETA1,SCSEP,LSEP,
IINIT,N4,CFTRA,CFF(65),AMETR,SLCTR
CCMNCN/CNFLTR/DLTA(4,2),HTA(4,2)
CCMNCN/TEMP/UC(65),EJAVE(65),THAVE(65),HAVE(65),UWAVE(65),
1EWAVE(65),LLAVE(65),D2SAVE(65),REAVE(65),TWAVE(65),DSTAVE(65),
2D4AVE(65),HWAVE(65),HVFAVE(65),UWAVE(65)
3*ELSTAV(65),CFIP(65)
CCMNCN/INIT/XINI,NF,N1,XMINF,AU,UEG,XMG,DELI2,THETA2,XMU,PQ,
1TINF,DELI,DELE,JEI,BJI,BWI,F1SQ,F2SQ,F1E,ThI,THE,XH,
2DELE,QINF,RO,XNU,RID3TW,SK1
CCMNCN/CONST/S2M3,S2M4,S2M5,C5,C5INI,S1I,S1I,S1I,S1I,S1I,S1I,
IC11,C12,C13,C14,C15,C16,Al,G1,G2
DIMENSION X(65)
EQUivalence (X,XTERP)
DIMENSION CFD3(65),CFD2(65)
DATA CFD3,CFD2/130*0.0/
DATA A1/.057/,F1SQ/.334/,F2SQ/.777/,F2E/1.2/,F1E/.47/,G1/.416/,
1G2/.134/,C23/-8.888/,C24/16.856/,C25/.00434/,C26/.9.492/,
2C11/.123/,C12/.678/,C13/.268/,C14/.0028/,C15/.1677/,C16/.C123/,
3S2M2/.5644/,S2M4/.4356/,S2M5/.4331/,C5/.185/,C5INI/.2/,C5INI/.2/,
4SM1/.178/,SM2/.786/,SK1/2.5/
DIMENSION CN(4),CA(4),CNP(4),CNF(4),CAF(4)
1,CMP(4),CMF(4),CM(4)
DIMENSION IPRNT(4),COEF(4),XN(4),ZN(4),ISF(2),XI(3),YI(3)
DATA LSF/6HUPPER,6FLOWER/
DATA IPRTN/1H1,1H2,1H3,1H4/
M=6
CL=C.

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```

CC=C.
CNM=C.
AC=4. 02*SCRIT(1C)
NPTS=NXUPTH(NC,2)
IF(FSMCH)1C,10,20
10  XNFS=C.01
CALL CUMPR(NPTS,IPFLAG,XNFS,O)
K1=0
2C DC 140 I=1,NC
DC 1:10 J=1,2
DC 1:10 J=1,2
IBL=C
N1=NXLOTH(I,1)
N2=NXUPTH(I,2)
IUM=0
ISURF=ISF(J)
GC TU (30,70),J
C   J=1 FCR UPPER SURFACE
3C DC CC K=N1,N2
KK=K-K1-N1+2
IF(S(K)-SSTAG(I))40,40,50
4C K1=K1+1
GC TO 60
5C STEM(K)=S(K)-SSTAG(I)
XTEMP(K)=XCT(K)
ITEMF(K)=K
ZTEMP(K)=ZCT(K)
MTEMP(K)=ML(K)
6C COUNTINUE
NP=KK
GC FC 90
C   J=2 FCR LOWER SURFACE
7C DC 8C K=1,K1
L=K
KK=N1+K1-K
SIEMP(K+1)=SSTAG(I)-S(KK)
XTEMP(K+1)=XCT(KK)
ITEMP(K+1)=KK
ZTEMP(K+1)=ZCT(KK)
8C MTEMP(K+1)=ML(KK)
NF=L+1
9C SIEMP(I)=0.
ITEMP(I)=0.
XTEMP(I)=XSTAG(I)

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    STEMF(1)=ZSIAC(1)
    IF(J.EQ.2) GO TO 97
    CALL LSG(MTEMP(NP-6),STEMP(NP-6),1,5,CNF)
    CCR=MTEMP(NP-6)-CNF(1)-CNF(2)*STEMP(NP-6)
    DC 52 K=1,7
    KK=NP+1-K
    MTEMP(KK)=CNF(1)+CNF(2)*STEMP(KK)+CCR
    CCNTINUE
95   CCNTINUE
    IF(J.EQ.2) GO TO 58
    TEM=MTEMP(NP)
    GL TC 95
    MTEMP(NP)=TEM
    XI(1)=STEMP(NP-4)
    XI(2)=STEMP(NP-3)
    XI(3)=STEMP(NP)
    YI(1)=MTEMP(NP-4)
    YI(2)=MTEMP(NP-3)
    YI(3)=MTEMP(NP)
    CALL PCINT(XI,YI,STEMP(NP-2),MTEMP(NP-2),1,3,A)
    CALL PCINT(XI,YI,STEMP(NP-1),MTEMP(NP-1),1,3,A)
    CCNTINUE
99   CCNTINUE
    DC 100 K=1,NP
    CALL POINT(STEMP,MTEMP,STEMP(K),YINT,1,NP,A)
    CALL SLCP(STEMP(K),A,DMDS(K))
    UE(K)=AC*MTEMP(K)*SQR((1.+0.2*MTEMP(K)**2)
    DEDS(K)=AC*DMDS(K)/(1.+0.2*MTEMP(K)**2)**1.5
    ICG CCNTINUE
    DC 110 K=1,NP
    CALL POINT(STEMP,DMCS,STEMP(K),YINT,1,NP,A)
    CALL SLUP(STEMP(K),A,DMDS(K))
    IIC CCNTINUE
    SEND=STEMP(NP)
    IF(INC.EQ.1) GO TO 120
    IF((J.NE.1).OR.(I.EQ.1)) GO TO 105
    CALL POINT(XCT,S,XFS(I-1,2),SEND,NXUPTH(I,1),NXUPTH(I,2),A)
    SEND=SEND-SSIAG(I)
1C5  IF((J.NE.2).OR.(I.EC.NC)) GO TO 120
    CALL PCINT(XTEMP,STEMP,XFS(I,1),SEND,1,NP,A)
    I2C CCNTINUE
    JN=IN-1
    CALL LAMNA2(NP,I,J,JN,IIR,SEND)
    PC=PC

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```

N1=6
INT=N4
IF((I.EG.1).OK.(J.EG.2)) SEND=STEMP(NP)
IF((IR.NE.2) CG TO 1128
IF((IN.GT.3) GU TO 1129
1122 CALL TURB2(NP,N1,I,J,JN,SEND)
GC TO 1128
1126 CALL TURB(HSEP,NP,I,J,JN,ISEP,SEND)
GC TO 1122
1128 CCNINLE
IF((I.EG.1).OK.(J.EG.2)) GU TO 130
CALL PCINT(STEMP,XTEMP,SEND,XEND,I,NP,A)
N1=A(4)
IF(X(N1)-XEND) 114,114,113
113 N1=N1-1
114 XINI=XEND*12.
X(N1)=XINI
NB=N1+1
WRITE(M,1C17) I11E,ISURF,I,JN
1C17 FORMAT(1H1,25X,32FCNFUENT BOUNDARY LAYER SUMMARY//30X,8A10,
15X,A6,7HSURFACE/112X,16HCMPONENT NUMBER,13,/112X,
216HITERATION NUMBER,13//)
NBD=N8
DC 1141 L1=NB,NP
1141 X(L1)=12.*X(L1)
N3=NXUPTH(I-1,2)
XINF=FSMCH
XB=(CK(I-1,I-1,1)+CK(I,I-1,2))/2.
DC 1145 L1=2,5
DC 1145 L2=1,2
1145 XB=XB+CK(L1,I-1,L2)*XFS(I-1,L2)**(L1-1)/2.
XB=12.*XB
TINF=TINFX
XNL=XNUX
N2=NXLTH(I-1,1)
XNC=M(N2)
CALL POINT(STEMP,MTEMP,SEND,XMC1,INT,NP,A)
UCG=(XMC+XNC)/2.*AC
UEG=AO*XMC1
UE(N1)=UEG
XNG=M(N3)*AG/UCG
IF(XMG-C.9)1155,1156,1156
1155 XNG=.9

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1156 CONTINUE
DELI=12.*DLTA(I-1,2)
IF((ISLO(I-1).EQ.1)) GO TO 1158
RAT=THI/DELI
IF(CELI-XH/2.) 1158,1158,1157
1157 DEL I=XH/2.
THI=CELI*RAT
IEL=1
1158 CONTINUE
DELE=12.*DLTA(I-1,1)
XINCC=XINI/12./CREF
XINCC=XH/12./CKEF
ALF=ALFA*57.295775
WRITEM,1016 TO,PO,FSMCH,XHDC,RN,XINUC,ALF,AU
1016 FORMAT(30H STAGNATION TEMPERATURE,10X,2H= ,F9.2,7X,18HDEGREES RANKIN
IE , 9X,19H STAGNATION PRESSURE,10X,2H= ,F11.3,7X,8HLB/SQ FT /,
230H FREESTREAM MACH NUMBER = 'F12.5,21X,1H, ,9X'
316HSLT HEIGHT, H/C, 13X,2H= ,F13.5/30H REYNOLDS NUMBER PER FJOT
4= 'F13.6,3X,7MILLION,10X,1H,,9X,14HSLCT EXIT, X/C,15X,2H=
5F13.5/3CH ANGLE OF ATTACK = 'F11.4,5X,7HDEGREES,10X,
61H ,9X,14HSPEED CF SCUND,15X,2H= ,F11.3,7X,6HFT/SEC/,
79X,3H X/C,1CX,3HS/C,1IX,1HM,8X, 9HDM/D(S/C),8X, 1HH,11X,7HTHETA/C,
86X,6HDEL S/C,8X,7HDELT A/C,/)
TEITH=SQRT((XCT(N3)-XCT(N2))*2+(ZCT(N3)-ZCT(N2))*2)
BJI=DELI
8WI=DELE/SKI
TR I=1HTA(I-1,2)
THE=THIA(I-1,1)
DELI2=DLTA(I,1)
THEIA2=THIA(I,1)
XN(N)=XMG
UC(N)=UGG
NTEMP(N)=UCG/AU
TEIT=12.*THE
THI=12.*THE
THE=12.*THE
DELI2=12.*DELI2
THEIA2=12.*THETA2
UINF=XMINF*AO/SQRT(1.0+C.2*XMINF**2)
DG 121 K=N1,NP
XM(K)=SQRT(1.0+((UEG/UE(K))**2)*(1.0/XMG**2-1.))
UC(K)=SQRT((UEG/XMG)**2+UE(K)**2-UEG**2)
1159 CONTINUE

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134 CCN11NUUE
      RG=1.0/1727.54E*PG/TINP
      S1CET=DELI+DELI2
      IF(XF-SLDELT) 141,141,142
      IC78=1
      DEL1=XH-DELI2
      U1HAVE(N1)=0.8
      UNHAVE(N1+1)=0.8
      U2SAVE(N1)=THAVE(N1)*1.68
      U2SAVE(N1+1)=THAVE(N1+1)*1.68
      THAVE(N1)=THEIAZ
      THAVE(N1+1)=THEIAZ
      HAVE(N1)=1.6
      HAVE(N1+1)=1.6
      UC(N1)=1./XMG
      UC(N1+1)=1./XMG
      B1AVE(N1)=DELI
      B1AVE(N1+1)=DELI
      B1I=DELI
      B1AVE(N1)=B1I
      B1AVE(N1+1)=B1I
      CLAVE(N1)=7.0*THAVE(N1)
      CLAVE(N1+1)=7.0*THAVE(N1+1)
      GC 1C 143
      CALL CONF5(IC78,CFL3,CFD2,I,J)
142  CCN11NUUE
      IF(IC78.EQ.0) GC TO 299
      NB=N1
      IF(IC78.EQ.1) CALL CONF7(IC78,I,J)
      DC 1432 K=NB,N1
      KL=K
      IF(LC(K)-1.0) 1434,1434,1432
1432 CCN11NUUE
      GC TO 1436
1434 IUM=1
      XSEP=XTEMP(KL)/12./CREF
      SSEP=STEMP(KL)/12./CREF
1436 NB=N1
      IF((ILM.EQ.1).OR.(IC78.EQ.1)) CALL CONF8(I,J)
      IF(ILM.EQ.1) GO TO 1446
      DC 1442 K=NB,N1
      KL=K
      IF(U(K)-1.0) 1444,1444,1442

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1442 CONTINUE
1444 IUM=1
      XSEP=XTEMP(KL)/12./CREF
      SSEP=STEMP(KL)/12./CREF
1446 IF(IUM.EQ.1) WRITE(N,2006) XSEP,SSEP
      IF(IUM.EQ.1) ISEP=1
      2006 FORMAT(41HC U.M HAS BECOME LESS THAN 1.0 AT X/C = ,F11.6,8X,
      15+S/C = ,F11.6)
      2007 IF(IEL.EQ.1) WRITE(N,2007)
      2007 FORMAT(45HC SLCT BOUNDARY LAYER EXCEEDS HALF SLOT GAP )
      N4=N1+1
      KIAN=REAVE(N1)
      THETA1=THAVE(N1)/12.
      HN11=HAVE(N1)
      CF1RA=THAVE(N1)*2./RO/UINF**2
      ARETR=MTEMP(N1)
      SLOIR=DMDS(N1)
      DC ECO K=N1,NP
      3CC   X(K)=X(K)/12.
      NE=N1+1
      NB=NBD
      DC 3C5 K=NB,NE
      IA=ITEMP(K)
      CF1IA=CFIP(K)
      DLIAS(IA)=CLSTAV(K)/12.
      IA=ITEMP(NB-1)
      DLIAS(IA)=(DLTAS(IA-1)+DLSTAV(NB)/12.)/2.
      CF1(IA)=(CF1(IA-1)+CF1((IA+1))/2.
      IF(N4.EC.NP) GO TO 130
      IF(LN.LE.3) CALL TFB2(NP,N1,I,J,JN,SEND)
      IF(LN.GT.3) CALL TURBSEP(NP,I,J,JN,ISEP,SEND)
      130  CONTINUE
      IF(INC.GT.1) GO TO 1302
      NB=NXLCTH(I,1)
      IF(J.EQ.1) NB=NXUPTH(I,2)-6
      CALL LSC(DLTAS(NB),S(NB),1,7,CNF)
      CCR=DLTAS(NB)-CNF(1)-CNF(2)*S(NB)
      IF(J.EQ.2) CCR=DLTAS(NB+6)-CNF(1)-CNF(2)*S(NB+6)
      DC 1205 KK=1,7
      K=NB-1+KK
      DLIAS(K)=CNF(1)+CNF(2)*S(K)+COR
      1305 CONTINUE

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13C2 CCNTINUE
13I0 CALL LOAD(INP,I)
CNP(I)=CNP(I)
CN(I,IN)=CN(I)
CA(I)=CAP(I)+CAF(I)
CA(I)=-CMP(I)
140 CCN1 INUE
DC 150 I=1,NC
N1=NXLGTH(I,1)
N2=NXLUTH(I,2)
N3=NXLPTH(I,2)
DEF=(ZCT(N1)+ZCT(N3)-2.*ZCT(N2))/(XCT(N1)+XCT(N3))-12.*XCT(N2)
DEF=-DEF
CDEF(I)=(ATAN(DEF)+ALFA)*57.2957795
XN(I)=XCT(N2)
ZN(I)=ZCT(N2)
15C CCN1 INUE
DC 160 I=1,NC
CIER=CDEF(I)/57.2957795
CL=CL+(CN(I)*CCS(CTERM)-CA(I)*SIN(CTERM))
CD=CE+(CN(I)*SIN(CTERM)+CA(I)*COS(CTERM))
160 CNM=CN-(XN(I)*CN(I)-ZN(I)*CA(I))*CCS(CTERM)/CREF
1+(ZN(I)*CN(I)+XN(I)*CA(I))*SIN(CTERM)/CREF
2-CMP(I)
ALF=ALFA*57.2957795
WRITE(M,1000) TITLE,FSMCH,ALF,RN,CREF,JN
1CCC FCRMAT(1H1,55X,19HLOADS SUMMARY SHEET//25X,BALO//112H MACH NUMBER,13X,2H=,F20.6,18X,15HANGLE OF ATTACK,10X,2H=,F20.6/
219H REYNOLDS NUMBER/FT,6X,2H=,F20.6,2X,7HMILLION,9X,115HREFERENCE CHERC,10X,2H=,F20.6/112X,16HITERATION NUMBER,13,//)
1OC1 FCRMAT(10HCCMFLEN,33X,4(A1,22X))
WRITE(M,10C1) (PN(I),I=1,NC)
WRITE(M,10C1) (PRN(I),I=1,NC)
1OC1 FCRMAT(17HCLOCATION OF NUSE/8X,2HX=,13X,4(3X,F20.6))
1CC2 FCRMAT(10X*2HZ=,11X,4(3X,F20.6))
1CC3 FCRMAT(10X*2HZ=,11X,4(3X,F20.6))
1CC4 FCRMAT(7HOCHORD=,16X,4(3X,F20.6))
1CC5 FCRMAT(22H CCMFLNENT DEFLECTION=,1X,4(3X,F20.6))

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1CCC FCRMAT(14HCMCRML FORCES/10X,11H(CN)PRESS.=,2X,4(3X,F20.6))
      WRITE(M,1CC6) (CNP(I),I=1,NC)
      WRITE(M,1009) (CAP(I),I=1,NC)
1CCS FCRMAT(13HCAZIAL FORCES/10X,11H(CA)PRESS.=,2X,4(3X,F20.6))
      WRITE(M,1010) (CAF(I),I=1,NC)
1C1C FCRMAT(10X,11H(CA)ST-EAR =,2X,4(3X,F20.6))
      WRITE(M,1011) (CA(I),I=1,NC)
1C11 FCRMAT(10X,11HCA
      =,2X,4(3X,F20.6))
      WRITE(M,1012) (CMF(I),I=1,NC)
1C12 FCRMAT(22HCMCMNT AEGUT THE NOSE/10X,11H(CM)PRESS.=,2X,4(3X,F20.6)
      1)
      WRITE(M,1015) CL, CC, CM
1015 FCRMAT(//24H TOTAL LIFT COEFFICIENT =,6X,F20.6//
      124H TOTAL DRAG CCEFFICIENT =,6X,F20.6//,
      226H TOTAL MCEMENT CCEFFICIENT =,4X,F20.6/
      323H (ABEGUT THE PCINIT(0,0)))
      RETURN
      END

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SUBROUTINE LAMMA2(NP,IC,JS,JN,ITRAN,SENU)
COMMON XLGTH(4,2),XNUPTH(4,2),CH(4),XCT(165),ZCT(165),THETA(165),
IS(165),XPC(165),2PCT(165),NG,TITLE(8),ALFA,FSMCH,ML(165),
2V(165),CP(165),3V(165),XSTAG(4),ZSTAG(4),TSTAG(4),SSTAG(4),
3LTRAN(4,2)*XTRAN(4,2),ZTRAN(4,2),P,TD,RN,PRR,XK,NCU,IPLOT,
4CF(165),ULFAS(165),CREF,THCK(165),GVBT(165),VVBT(165),
SULIASP(165),GVBD(165),VVBDP(165),CNN(4,10),
6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2),
7,ISLET(2),
226CC0000
CLWMCN/TURBTR/SCRIT,RECRIT,STRAN,KTRAN,THETA1,SCSEP,LSEP,
1HINIT,N4,CFTRA,CFF(65),AMETR,SLUTR
2261C0000
COMMON/VISSOUS/ SUMS(65),AME(65),SLU(65),UE(65),
1DDRES(65),X(65),ISURF,ITEMP,ZTEMP(65)
2*XM(65),FINF,XNU
2262C0000
COMMON/LAMTR/SW,AC,VU,SEP,C,AMU,SQ,BT,F,ALPFA,H(65),HLI(65),
1ANTK(65),REMI(65),K,UET1(65),UET2(65),KUN,CN(65),UET(65),
2XKAY(65),RTCR(65),KBAR(65),RTHTR(65),REMOM(65),SG(65),VM(65),
3LFL(65),MBL(65),MUF(65)
2263C0000
COMMON/PBLBK/DISP
REAL KBAR,LBL,MBL,ML,F
2264C0000
DIMENSION IFLAG(6),CUCUBE(4),DISP(65),AMTKOC(65),DISPOC(65),
1SSG(65),XSAVE(3),AL(65),TAW(65),GFCNU(65),AUORE(65),SKINFR(65),
2REW(65),TEMSLO(65),CFBAR(65),CROOT(6)
2265C0000
EQUivalence(ICNSTAG,CNL1),(HLISTG,HLI(1)),(HSTAG,HLI(1))
M=6
2266C0000
IF(LLTRAN(IC,JS).NE.1) XTRAN(IC,JS)=0.
2267C0000
FACT=1.0
2268C0000
ANEIF=FSMCH
2269C0000
IF(FSMCH-.C1)10,LC,20
2270C0000
10 ANEIF=.C1
2271C0000
20 CONTINUE
2272C0000
DC 3C I=1,6
30 IFLAG(I)=0
2273C0000
LCN=C
2274C0000
2275C0000
2276C0000
2277C0000
2278C0000
ANEIF=FSMCH
2279C0000
IF(FSMCH-.C1)10,LC,20
2280C0000
10 ANEIF=.C1
2281C0000
20 CONTINUE
2282C0000
DC 3C I=1,6
30 IFLAG(I)=0
2283C0000
LCN=C
2284C0000
2285C0000
2286C0000
SW=XK*(1.+2*PRK**2*(1./3.)*AMEIF**2)/(1.+2*AMEIF**2)-1.
2287C0000
SEP=.C6561C58-.0355712*SW+.06717244*SW**2
2288C0000
CNSTAG=-.10644+.017250*SW+.375*SW**2
2289C0000
TWALL=TC*(1.+SW)
2290C0000
CUCUBE(4)=.7312+4.*32497*SW+12.*251*SW**2+21.*8919*SW**3+30.*92805*
1SW**4
2291C0000
CUCUBE(3)=-1.*227559-L.*662158*SW-9.*193*SW**2-13.*197*SW**3-17.*78815*
1SW**4
2292C0000
2293C0000

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CUCLEE(2)=-.CB8925+.3398894*SW+1.11802*SW**2+.990225*SW**3+
11.215532#SW**4
SW=-16.8327-2.*SW+2.9611*SW**2-41.293*SW**2
CE=22.49383+292.*SE11*SW+418.1659*SW**2
DE=-1748.459-8973.663*SW-1346.32*SW**2
E8=-334.05-34314.55*SW-4804.87*SW**2

A1=.44
B1=.565C3+2.*5133*SW
C1=2.195945-7.C6C7*SW
D1=-6.358574-13.647E4*SW
C=(1./6.)*SEP-(1./12.)*CNSTAG/(SEP*CNSTAG*(CNSTAG-SEP))
HSIAG=(-1.1138*CNSTAG+2.38411)*L.13*SW
HLIS1G=HSTAG/(1.+SW)
BT=-C*CNSTAG+1./CNSTAG
AC=45.02*SGRT(TO)
ARU=(ITC+198.6)/(IG*(1.+SW)+198.6)*SGRT(1.+SW)
TINF=T0/(1.+2*AMEIF*2)
AINF=4.02*SQR(TINF)
VRAT=(TINF/T0)**3.5*(TO+198.6)/(TINF+198.6)
RHGRAT=(1.+2*AMEIF*2)**2.5
VINF=AMEIF*AMF/RN/1.E06
VC=VINF/VRAT/RHRAI
XNU=VO
P=1716.*2.27*TC**2.5*1.E-08/(TO+198.6)/VO
A=A1-C1*CNSTAG**2-2.*DI*CNSTAG**3
B=B1+2.*C1*CNSTAG+2.*DI*CNSTAG**2
DC 40 K=L*NP
IF(AME(K))35,35,37
35 AME(K)=C*OC1
CONTINUE
37 UET(K)=AD*AME(K)
UE11(K)=AD*SLU(K)*(1.+0.2*AME(K)**2)**4/AMU*CH(1IC)
UE12(K)=AC*(1.+0.2*AME(K)**2)**3/AMU**2*DDMDS(K)*CH(1IC)
UE12(K)=UE12(K)+1.6*AU*(1.+2*AME(K)**2)*7/AMU**2*AME(K)*SLO(K)
1*2*CH(1IC)*2
K=2
DG 260 I=3.NP
IF(K.NE.2) GO TO 50
CA(K)=(-A*SLO(K))/AME(K)*SUMS(K)/2.
DEL CUT=C.
50 DC 1C 70
K=1
J=K-1

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6C FIG51=(1.+2*AME(J)*#2)**4
7C SC=AME(K)*AME(K)
FIG52=(1.+2*SQ)*#4
KEAR(K)=0.
KHTIK(K)=C.
IF(K.EQ.2) GO TO 8C
IF(AES(SLO(K))-1.E-6)>72,74,74
72 SGN=SIGN(1.0,SLO(K))
SLO(K)=1.E-6#SGN
74 CONTINUE
CN(K)=SLC(K)*FIG52*CN(J)*AME(K)**B/
1*(SLC(J)*FIG51)-A*AME(K)**(-B)*SLO(K)*FIG52*(AME(K)
2*(*B-1.)/FIG52+A*ME(J)**(B-1.)/FIG51)*(SUMS(K)-SUMS(J))/2.)
8C IF(CN(K)-CNSTAG+DELCLUT)>90,100,100
90 IF(CELCLUT)>92,94
92 FACT=FACT+10.E-5
94 CONTINUE
CN(K)=(CNSTAG-DELCLUT)*FACT
100 IF(CN(K)-IC**SEP)>IC,110,105
1C5 CN(K)=10.*SEP
11C B=B1+2.*C1*CN(K)+3.*D1*CN(K)**2
A=A1-C1*CN(K)**2-2.*D1*CN(K)**3
12C CONTINUE
F=1.+17504*SQ+.6*SQ+.42171*SW*SQ+.008832*SC*SQ
1+.C6C343*SH*SQ*SQ+.18253*SW*SW+.073*SW*SW
2*SQ+.CC73*SW*SQ*SQ
TAU(K)=TU*(1.+2*SQRT(PRR)*SQ)/(1.+2*SQ)
ANIK(K)=SQRT(ABS(
V0*AMU*(-CN(K))/(AC*SLO(K))*(
ANIK(K)=SQRT(ABS(
V0*AMU*(-CN(K))/(AC*SLO(K))*(
1*(1.+2*SQ)**2)
ALPH#1./3.+BT*CN(K)+C*CN(K)**2
H(K)=1.-1.1138*CN(K)+2.38411*(1.+1.18*((1.+2*SQ)-1.))
1+2*PRR**ALPHA**SQ
HLI(K)=(H(K)-PRR**ALPHA**2*SQ)/(1.+SQ)/(1.+2*SQ)
DISP(K)=AMIK(K)*H(K)
ANTKC(K)=AMIK(K)/CH(IIC)
DISPC(K)=DISP(K)/CH(IIC)
CCCUBE(1)=.0715016-.04559*SW+.04871*SW**2-CN(K)
CALL PRCT(CDCUBE,CROOT)
JSAVE=C
DC 160 IK=1,6,2
IF((CRCOT(IK).LT.0.C.C).OR.(CRUOT(IK).GT.0.7)) GO TO 160
JSAVE=JSAVE+1
XSAVE(JSAVE)=CRUGT(IK)

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160 CONTINUE
170 IF(JSAVE) 170,170,180
170 AL(K)=0.
GC TO 200
180 XMIN=1C.0
DC 190 IK=1,JSAVE
190 XMIN=AMIN1(XSAVE(IK),XMIN)
AL(K)=XMIN
200 CONTINUE
SKINFR(K)=2.*AL(K)*SQRT(ABS((SUMS(K))*(-SLG(K)/CN(K))/(
1AM(E(K)) )
CFNL(K)=2.*CO+B8*CA(K)+C8*CN(K)**2+D8*CN(K)**3+E8*CN(K)**4
ANUCRE(K)=(SKINFR(K)*PRR**ALPHA)/CFONU(K)
RENOM(K)=AC*AMTK(K)*AME(K)/(FIG52*VO*AMU*(1.+SW)**2)
REM(IK)=AU*AMTK(K)*AME(K)/(1.+2*SW)**4.5*VO*F)
REW(K)=REMCM(K)*(SUMS(K))
/AMTK(K)
TEM*SLUG(K)=SQRT(REW(K))*ANORE(K)*(TAN(K)-TWALL)
1/(SUMS(K))
SG(K)=SKINFR(K)/SQRT(REW(K))
IF(K-2)220,210,220
210 EVAL=SQ*(1.+2*SQ)**(-4.5)*SG(K)*SUMS(K)/2./CH(IC)
GC TO 230
220 EVAL=EVAL+(SQ*(1.+2*SQ)**(-4.5)*SG(K)+AME(J)**2*
1*(1.+2*AME(J)**2)**(-4.5)*SG(J)*(SUMS(K)-SUMS(J))/2./CH(IC)
230 CFBAR(K)=1./(1.+SW)*1./AMEIF**2*(1.+2*AMEIF**2)
1**3.5/SUMS(K)*EVAL/CH(IC)
SSG(K)=SG(K)/(1.+SW)*(AME(K)/AMEIF)**2*((1.+2*AMEIF**2)-
1*(1.+2*AME(K)**2)**3.5/(1.+2*AME(K)**2)
IA=ITEMP(K)
DLIAS(IA)=DISP(K)
CFI(IA)=SSG(K)
CALL BLTRAN(IITRAN,IFLAG,IC,JS,NP,SEND)
I(IITRAN)50,26C,240
240 N4=K
NFI=K
250 N3=K-1
GC TO 270
260 CONTINUE
270 CONTINUE
WRILEM,10C) TITLE,ISURF,IC,JN
100C FORMAT(1H1,25X,3CHLAMINAR BOUNDARY LAYER SUMMARY//30X,8A10,5X,A6,
17+ SURFACE/112X,16HCOMPONENT NUMBER,13,,//)
2112X,16HITERATION NUMBER,13,,//)
24220000

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SCRIT=SCRIT/CREF
STRN=STRAN/CREF
TET1=TET1/CREF
ANGL=ALFA*57.2557755
XST=XSTAG(IC)/CREF
ZSI=ZSTAG(IC)/CREF
WRITE(N,1001)ID,P,AMEIF,CH(IC),RN,PRR,XK,SEF,AU,VU,ANGL
1,XST,ZSI
1CC1 FFORMAT(20H STAGNATION TEMPERATURE = ,2X,F7.2,7X,
118H DEGREES RANKINE ,19X,31INSTAGNATION PRESSURE ,19X,30H FREESTREAM MACH NUMBER = ,F11.3,5X,10H LB/SQ FT/
230H REYNOLDS NUMBER = ,F12.5,21X,1H,9X,13HAIRFUIL CHOR
30,16X,1H=,5X,F7.3,7X,2HFT/30H REYNOLDS NUMBER PER FOOT = ,F13.6,4/
43X,7H MILLION,10X,1H,9X,14HPRANDTL NUMBER = ,F13.6,4/
522H FEAT TRANSFER FACTOR K,5X,1H=,F12.4,22X,1H,9X,
631H SEPARATION CORRELATION NU. = ,F14.6/
715H SPEED OF SOUND,13X,1H=,F11.3,6X,6HFT/SEC,11X,1H,9X,
815H KINEMATIC VISCOSITY,10X,1H=,F17.8,11H SC FT/SEC/
916H ANGLE OF ATTACK,12X,1H=,F12.4,5X,7HDEGREES,10X,1H,9X,/,
118H STAGNATION AT X/C,10X,1H=,F16.8,18X,1H,8X,18H STAGNATION AT Z
2/C,12X,1H=F17.8)
WRITE(M,10C2)
1CC2 FFORMAT(1HG,8X,3HX/C,10X,3HS/C,11X,1HM,8X,9HDM/D(S/C),7X,1HH,11X,
17HTET1/C,6X,6HDELS/C,8X,7HDELTA/C,6X,2HCF/)

DC 280 K=2,NPT
XCC=x(K)/CREF
SCC=SUMS(K)/CREF
DMDS=CREF*SLOCK(K)
TCC=AMTK(K)/CREF
DCC=CISP(K)/CREF
28C WRITE(M,1CC3)XOC,SOC,AME(K),DMDS,H(K),TOC,DCC,SSG(K)
1CC3 FFORMAT(1H,7F13.6,12X,F13.6)
WRITE(M,10C4)
1CC4 FFORMAT(1H0,/,10X,1H,12X,1HL,11X,3HRE,3X,17HSKIN FR/SQRJ(REN),4X,
15HREND,7X,5HCFBAR,/)
DC 290 K=2,NPT
29C WRITE(M,10C5) CN(K),AL(K),REN(K),SG(K),REMEN(K),CFBAR(K)
1CC5 FFORMAT(1X,2F13.6,F12.3,F13.8,F13.4,F13.8)
IF(TTRAN.EQ.1) RETURN
WRITE(M,1CC6) SCRIT,RECIT,STRN,RTRAN,THEI
10C6 FFORMAT(1H0,9HSCRIPT/C=,F13.8,3X,8HRECRIF = ,F10.2,5X,
19HSTRAN/C = ,F13.8,2X,7HTRAN = ,F10.2,2X,1CHTHEIA1/C = ,F13.8,/,
CALL POINT(SUMS,X,STRAN,XTRAN(IC,JS),1,NP,A)
24240000
24250000
24260000
24270000
24280000
24290000
24300000
24310000
24320000
24330000
24340000
24350000
24360000
24370000
24380000
24390000
24400000
24410000
24420000
24430000
24440000
24450000
24460000
24470000
24480000
24490000
24500000
24510000
24520000
24530000
24540000
24550000
24560000
24570000
24580000
24590000
24600000
24610000
24620000
24630000
24640000
24650000

```

```

DC 370 I=1,6
1F(IFLAG(1)370,37C,300
30C GU TO (210,220,230,240,35C,360),I
310 XIR=>TRAN(IC,JS)/CREF
      WRITE(M,1CC7) XIR,STRN
1CC7 FFORMAT(47HINSTABILITY TRANSITION HAS OCCURRED AT X/C =,F11.6,
18X,SHS/C =,F11.6)
      GC TO 370
320 XIR=>TRAN(IC,JS)/CREF
      WRITE(M,1OC8) XIR,STRN
1CC8 FFORMAT(41HCFIXED TRANSITION HAS OCCURRED AT X/C =,F11.6,
18X,SHS/C =,F11.6)
      GC TO 370
330 XIR=>TRAN(IC,JS)/CREF
      WRITE(M,1CC9) XIR,STRN
1CC9 FFORMAT(49HOCURLE LAMINAR SEPARATION HAS OCCURRED AT X/C =,F11.6,
18X,SHS/C =,F11.6)
      GC TO 370
340 XIR=>TRAN(IC,JS)/CREF
      WRITE(M,1010) XIR,STRN
101C FFORMAT(46HOCN LAMINAR SEPARATION HAS OCCURRED AT X/C =,F11.6,
18X,SHS/C =,F11.6)
      GC TO 370
35C WRITE(M,1011)RTRAN
1011 FFORMAT(13HOSHORT BUBBLE,10X,25HTRANSITION REYNOLDS NO. =,F13.6)
      GC TO 370
36C WRITE(M,1012)RTRAN
1012 FFORMAT(12HOLONG BUBBLE,10X,25HTRANSITION REYNOLDS NO. =,F13.6)
      370 CCONTINUE
      IF(LTRAN(IC,JS).GT.,C) HINIT=1.45
      REILFN
      END

```

```

SUBROUTINE BLTRAN(ITRAN,IFLAG,IC,JS,NP,SEND)
CMMCN NXLOTH(4,2),NXJPTH(4,2),CH(4),XCT(165),ZCT(165),THETA(165),
IS(165),XPC(165),ZPC(165),NC,TITLE(8),ALFA,FSMCH,ML(165),
2VT(165),CP(165),GV(165),XSIA(4),ZSTAG(4),TSTA(4),SSTAG(4),
BLTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,REN,PRR,XK,NCU,IPLJT,
4CF(165),DLTAS(165),CREF,THCK(165),GVBT(165),VVB(165),
5DLIASP(165),GVBD(165),GVBDP(165),VVBDP(165),CNN(4,10),
6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2)
25050000
25060000
25070000
25080000
25090000
25100000
25110000
25120000
25130000
25140000
25150000
25160000
25170000
25180000
25190000
25200000
25210000
25220000
25230000
25240000
25250000
25260000
25270000
25280000
25290000
25300000
25310000
25320000
25330000
25340000
25350000
25360000
25370000
25380000
25390000
24980000
24990000
25000000
25010000
25020000
25030000
25040000
25050000
25060000
25070000
25080000
25090000
25100000
25110000
25120000
25130000
25140000
25150000
25160000
25170000
25180000
25190000
25200000
25210000
25220000
25230000
25240000
25250000
25260000
25270000
25280000
25290000
25300000
25310000
25320000
25330000
25340000
25350000
25360000
25370000
25380000
25390000
24 1 ISLT(3)
CCMMCN/VISSOUS/ SUMS(65),AME(65),SLO(65),UE(65),UE1(65),
1DEMDS(65),X(65),ISURF,ITEMP(65),ZTEMP(65),
CCMMCN/LAMIR/Sh,AC,VG,SEP,C,AMU,SQ,BT,F,ALPHA,H(65),
IANTK(65),REMI(65),K,UET(165),UET2(65),KGN,CN(65),UET(65),
2XKAY(65),RTCR(65),KBAR(65),RTHTR(65),REMOM(65),SG(65),VM(65),
3LBL(65),MBL(65),MUF(65)
CCMMCN/CNFLTR/ELTA(4+2),THA(4,2)
DGUBLE PRECISION A
DIMENSION A(4),IFLAG(6)
CCMMCN/TURBIR/SCRIT,RECRI,T,STRAN,RTRAN,THETA1,SCSEP,LSEP,
IINIT,N4,CFTRA,CFF(65),AMETR,SLCTR
EQUIVALENCE(CNSIA(4),CN(1)),(LBLST,LBL(1))
REAL LBL,MBL,MUF,LSEP,LBLK,KBAR,LBLST
PI=3.1415927
ITRAH=0
J=K-I
CALL POINT(SUMS,X,SEND,XEND,1,NP,A)
AMEIF=FSMCH
IF(FSMCH-.C1)10,1C,20
10 AMEIF=.01
20 CONTINUE
LBLST=.0855
CCN1=EXP(43.37458*(767+218.28*.C767**2-1934.6*.0767**3
1-2396C.*.C767**4+.46963)
XNWN=(1.+2*SQ)**2*AMU*(1.+SW)**2)/F
VN(K)=VO*(1.+2*AMU(K)**2)**1.5*F
LBL(K)=(AMTK(K)**2*UET1(K))/(VN(K)*(1.+2*AME(K)**2)
1*6*CH(IC))
MBL(K)=(UET(K)*UET2(K))/UET1(K)**2*LBL(K)**2
LBLK=LBL(K)
IF(LELK+.13)30,40,40
30 LBLK=-.13
40 F1=0.04860539+C.7859649*LBLK+1.97856*LBLK**2-3.*389716*LBLK**3

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```

1+27*(1734*LBLK**4
G1=0.150354*0.9317C23*LBLK+3.*230259*LBLK**2+41.0025*LBLK**3
1-178.*249*LBLK**4-167C.592*LBLK**5
MLF(K)=F1/G1
5C XKAY(K)=REMI(K)**2
IF(XKAY(K)-0.0767)7C,70,60 *F*VU/AU/SU*SLU(K)
6C XKAY(K)=.C767
GC IC 90
7C IF(XKAY(K)+.1567)8C,80,9C
8C XKAY(K)==.1567
9C RTCCR(K)=EXP(5.46963+43.3745*XXKAY(K)+213.*28*XXKAY(K)**2
1-1934.*6*XXKAY(K)**3-23980.*XXKAY(K)**4)
IF(K-2)130,110,150
1C ITRN=-1
RETURN
11C CCNTINUE
IF(RICR(K)-REMI(K))120,120,240
12C SCR11=CCN1* SUMS(K)/(REMI(K)-RTCR(2)+CCN1)
RECRIT=REMI(K)*SCRIT/SUMS(K)
GC TO 170
13C IF(KCN-1) 140,18C,180
140 KCH=1
IF(RTCR(K)-REMI(K))150,150,163
15C IF(KCN-1)16C,180,180
16C KCN=1
GC IC 165
163 KCH=C
165 SCR11=SUMS(J)+(RTCR(J)-REMI(J))*(SUMS(K)-SUMS(J))
1/(REMI(K)-REMI(J)-RTCR(K)+RTCR(J))
IF(SCRIT)166,167,167
166 SCR11=C.
167 IF(SCRIT-SUMS(NP))169,169,168
168 SCR11=SUMS(NP)+C.CCI*CH(HC)
169 CCNTINUE
RECRIT=REMI(J)+(SCRIT-SUMS(J))*(REMI(K)-REMI(J))
1/(SUMS(K)-SUMS(J))
17C CALL POINT(SUMS,A,E,SCRIT,AMECR,1,NP,A)
CALL SLOPE(SCRIT,A,SLOCR)
EXKA=RECRIT**2/CH(HC)*(1.+.17504*AMECR**2+
1.*6*SW+.42171*SW*AMECR**2+.008832*AMECR**4+
2.*C6C243*SW*AMECR**4+.18253*SW*SW+.C73*SW*SW
3*AMECR**2+.0073*SW*AMECR**4)*VO/AJ/AMECR**2*SLOCR*CH(HC)
ACD=(XKAY(K)+EXKA)*(SUMS(K)-SCRIT)/2.
258200300

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GC TO 190
18C ADD=ADD+(XKAY(K)+XKAY(J))*(SUMS(K)-SUMS(J))/2.
19C KEAR(K)=ADD/(SUMS(K)-SCRIT)
19I IF(KEAR(K)+.C5)20C,210,210
20O KEAR(K)=-.C5
21O CCNTINUE
215 BGM=F25.45+28183.5*KBAR(K)+721988.*K3AR(K)**2+6317380.*KBAR(K)**3
      RTHTR(K)=BGM+RECRT
      IFKCH)215,215,217
      KC#=1
      GC TO 350
217 CCNTINUE
      IF(K-2)330,220,330
220 IF(RTHTR(K)-REMI(K))230,230,240
230 STRAN=SCRIT+(RTHTR(K)-RECRT)*SUMS(K)/(REMI(K)-
      IRICR(K)+CONI)
      IFLAG(1)=1
      GC TO 320
240 IF(SUMS(K)-SEND) 245,250,250
245 IF((LTRAN(IC,JS).LE.C) GO TO 260
      IF(X(K)-XTRAN(IC,JS))100,250,250
250 IFLAG(2)=1
      STRAN=SUMS(K)*(XTRAN(IC,JS)-XSTAG(IC))/(X(K)-XSTAG(IC))
      GC IC 320
26C IF(MUF(K)-NBL(K))27C,28C,280
27C IFLAG(3)=1
      LSEP=MUF(K-1)/(NBL(K)-(LBL(K)-LBLST)-(MUF(K-1)-MUF(K))/(
      (LBL(K)-LBLST)+LBLST
      STRAN=SUMS(K)*(LSEP-LBLST)/(LBL(K)-
      1LBLST)
      SCSEP=STRAN
      GC TO 320
28C IF(INC(2)-SEP)1CC,290,290,1CC
29C IF(CN(2)-SEP)1CC,30C,300
30O IFLAG(4)=1
310 STRAN=SUMS(K)*(SEP-CNSTAG)/(CN(K)-CNSTAG)
      LSEP=LBL(K-1)+(LBL(K)-LBLST)*STRAN/SUMS(K)
      SCSEP=STRAN
32C RTRAN=STRAN*REMI(K)/SUMS(K)
      GC TO 5CO
330 IF(RTHTR(K)-REMI(K))340,340,350
340 STRAN=SUMS(J)+(RTHTR(J)-REMI(J))*(SUMS(K)-SUMS(J))
      1/(REMI(K)-REMI(J)-RTHTR(K)+RTHTR(J))

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```

1 IFLAG(1)=1
2 GC TC 420
3 IF(SUMS(K)-SEND) 355,360,360
4 IF(LTRAN(IC,JS)*L.E.0) GO TO 370
5 IF(X(K)-XTRAN(IC,JS))370,360,360
6 IFLAG(2)=1
7 GC TO 420
8 370 IF(NCU) 39C,39C,38C
9 IF(MUF(K)-MLB(K)) 410,60C,600
10 IF(CN(K)-SEP)6CC,4CC,400
11 IFLAG(4)=1
12 GC TC 420
13 LSEP=(MUF(K-1)-MLB(K-1))/((MLB(K)-MLB(K-1))/(LBL(K)-LBL(K-1))-  

14 MUF(K-1)-MUF(K))/(LBL(K)-LBL(K-1))+LBL(K-1)
15 IFLAG(3)=1
16 STRAN=SUMS(K-1)+(SUMS(K)-SUMS(K-1))*(LSEP-LBL(K-1))/  

17 ((LBL(K)-LBL(K-1)))
18 SCSEF=STRAN
19 CCNT INLE
20 IF(SUMS(K)-SEND) 422,421,421
21 XTRAN(IC,JS)=XEND
22 GC TO 423
23 IF(LTRAN(IC,JS).LE.0) GO TO 427
24 AN=XLCTH(IC,2)
25 NT=XLOTH(IC,1)
26 ARG=Z*(XTRAN(IC,JS)-XCT(NN))/(XCT(NT)-XCT(NN))-1.0
27 IF(AES(ARG)-1.0) 4225,4235,4232
28 ARG=SIGN(1.0,ARG)
29 IT=ACOS(ARG)
30 IT-TR1=2.*PI-ITHT
31 IT-TR2=ITHT
32 CALL PCINT(THETA,ZC1,THTR1,ZTR1,NXLOTH(IC,1),NXUPTH(IC,2),A)
33 CALL POINT(THETA,ZCT,ZTR2,ZTR2,NXLOTH(IC,1),NXUPTH(IC,2),A)
34 D1=AES(ZTRAN(IC,JS)-ZTR1)
35 D2=AES(ZTRAN(IC,JS)-ZTR2)
36 IF(D2-D1)424,425,425
37 IT-TR=ITHR2
38 GC TO 426
39 IT-TR=ITHR1
40 CALL PCINT(THETA,S,1HTR,STK,NXLOTH(IC,1),NXUPTH(IC,2),A)
41 STRAN=STR-SSTAG(IC)
42 IF(NCU)430,430,49C
430 IF(CN(K)-SEP)49C,49C,440

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440 IF (IFLAG(1)+IFLAG(2)-1)460,450,450
450 STTRAN=STRAN
460 CALL POINT(CN,SUMS,SEP,STRAN,K-2,K,A)
461 IF(SUMS(K)-STRAN)466,469,462
462 IF(SUMS(K-1)-STRAN)469,465,408
463 STRAN=SUMS(K-1)+(SUMS(K)-SUMS(K-1))/(CN(K)-CN(K-1))*(SEP-CN(K-1))
464 CONTINUE
465 LSEP=LBL(K-1)+(LBL(K)-LBL(K-1))*(STRAN-SUMS(K-1))/(SUMS(K)-
466 SUMS(K-1))
467 SCSEF=STRAN
468 IFLAG(4)=1
470 IF(IFLAG(1)+IFLAG(2)-1)49C,4d0,480
480 STRAN=STRAN
490 KTRAN=REMI(J)+(STRAN-SUMS(J))*(REMI(K)-REMI(J))/(SUMS(K)-SUMS(J))
500 CALL POINT(SUMS,AME,STRAN,AMETR,1,NP,A)
501 IF(MLF(K)-LBL(K))520,510,510
510 IF(CN(K)-SEP)55C,E2C,520
520 RCTRAN=RTRAN*(1.0+0.2*AME(K)**2)*2.5/XNW/NM
521 PG=-C.C2*REMCM(K)-1.0
530 IF(FC-SLO(K)*CH(IC))530,540,540
530 IFLAG(5)=1
531 GC TO 550
540 IFLAG(6)=1
550 IF(AMETR)560,57C,57C
560 AMEIR=1.E-9
570 CCN1INUE
571 CALL SLOPE(STRAN,A,SLOTR)
572 CALL POINT(SUMS,HLI,STRAN,HINI,1,K,A)
573 IF(RTRAN)58C,58C,59C
580 RTRAN=1.01
581 DEFGRM=.7928916+.C6590697*ALOG(RTRAN)-.001271763*(ALOG(RTRAN))*#2
582 HINIT=HINI-DEFORM
583 CALL POINT(SUMS,AMIK,STRAN,THEtal,1,K,A)
584 THEtal=THEtal*HINI/(HINI-DEFORM)
585 CALL POINT(SUMS,SG,STRAN,CFTRA,1,K,A)
586 CFTRA=CFTRA*(1.+0.2*AME(K)**2)/(1.+SW)
587 IF(XTRAN(IC,JS)-XEND+0.1E-6*CH(IC))705,705,707
705 ITTRAN=2
706 GC TC 600
707 ITTRAN=1
708 CALL PCINT(X,SUMS,XEND,STRAN,K-2,K,A)
709 CALL POINT(SUMS,AMIK,STRAN,THEtal,K-2,K,A)
710 CALL POINT(SUMS,AMIK,STRAN,THEtal,K-2,K,A)
711 GC TO 500

```

INITIAL
CLIA(IC,J\$)=THEIAL
6CC RETURN
END

2712C0000
2713C0000
2714C0000
2715C0000

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SUBROUTINE TURB2(INF,NI,IC,JS,JN,SEND)
REAL KF,MTEMP,MHOLD
CCMMCN/VISCOS/XTEMP(65),MTEMP(65),DMDS(65),UE(65),DUES(65),
1DCMDS(65),X(65),ISRF,ITEMP(65),ZTEMP(65)
2,XM(65),TINF,XNUX
CCMNCN/CNFLTR/CLTA(4,2),HTA(4,2),
CCMNCN/TURBTR/SCRIT,RECIT,STRAN,RTRAN,THEtal,SCSEP,LSEP,
IHINI,N4,CFTRA,CFF(65),AMETR,SLOTR
CCMNCN/LAMTR/Sw,AQ,VU,SEP,CC,AMU,SQ,BT,F,ALPHA,HH(65),HLI(65),
IAMIK(65),REMI(65),K,UET1(65),UET2(65),KON,CN(65),UETR(65),
2XKAY(65),RICR(65),KEAR(65),RTHTR(65),REMQM(65),SG(65),VM(65),
3LBL(65),MBL(65),MUF(65)
CCMNCN NXLCITH(4,2),NXUPTH(4,2),C(4),XCT(165),ZCT(165),THETA(165),
1S(165),XPCI(165),ZPCT(165),NC,TITLE(8),ALFA,FSMCH,ML(165),
2VT(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),TSTAG(4),SSTAG(4),
3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,IPLT,
4CF(165),DLIAS(165),CREF,THCK(165),GVBT(165),VVBT(165),
5DLIASP(165),GVBD(165),GVBDP(165),VVBDP(165),CNN(4,10),
6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2),ISLCT(3),
DIMENSION HMEAN(65),HVMEAN(65),DEL1(65),DEL2(65),CFLOC(65),
1DSTR(65),TTA(65)
EQUivalence(XNU2,XNU1),(AMETR,XME),(ITIA,ANTK),(HMEAN,HH)
EQUivalence(STRAN,XINI),(AMETR,XME),(ITIA,ANTK),(HMEAN,HH)
L=6
WRITE(L,10C1) TITLE,ISURF,IC,JN
1CC1 FCRMAT(1H1,19X,55HTURBULENT BOUNDARY LAYER SUMMARY FOR EQUIVALENT
1AIRFCIL //25X,8A10, 5X
1,A6,7HSURFACE/107X,16HCOMPONENT NUMBER,13,/107X,16HITERATION NUMBER
2R,13,/)
SLC= STRAN/CREF
TH = THETA1/CREF
ANGL=ALFA*57.2557795
WRITE(L,10C0) TO,PO,FSMCH,C(IC),RN,PR,KF,SOC,TH,HINIT,ANGL
1COC FCRMAT(30H STAGNATION TEMPERATURE = ,2X,F7.2,7X,
113HDEGREES RANKINE
19X,31HSTAGNATION PRESSURE = ,F11.3,5X,10H LB/SQ FT/
23CH FREESTREAM MACH NUMBER = ,F12.5,21X,1H,9X,13HAIRFOIL CHOR
3D,16X,1H=.5X,F7.3,7X,2HF1/30H REYNOLDS NUMBER PER FOOT = ,F13.6,
43X,7HMILLION,10X,1H,.9X,14HPRANDTL NUMBER,15X,1H=.7X,F6.4/
522H FEAT TRANSFER FACTOR K,5X,1H=.F12.4,22X,1H,.9X,
621H TRANSITION POINT S/C,8X,1H=.F14.5,/
734H (INITIAL MOMENTUM THICKNESS)/C = ,F8.5,21X,1H,.9X,

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63CHINIT. INCCMPK. FCRM FACTOR = ,F14.5/16H ANGLE OF ATTACK,12X,
91H=,F12.4,5X,7HUEGREES,
      WRITE(L,1CC2)
1CC2 FCRMAT(1H0,4X,3HX/C,15X,3HS/C,9X,1HM,8X,8HDM/(S/C),7X,1HH,12X,
17H-1HETAC,5X,6HDEL'S/C,6X,7HDELTAC,6X,2HCF/)

XTK = XTRAN(LC,JS)/CREF
STR = STRAN/CREF
DMDX=SLCTR*CREF
DFRN=THETAI*HINIT/CREF
      WRITE(L,1CC3) XIR,SIR,AMERK,DMDX,HINIT,TH,DPRN,CFTRA
1CC3 FCRMAT(1H ,F10.6,2X,6F13.6,13X,F13.6)
20 CCNTINUE

C1=C*56
C2=.1667
C3=1.65
C4=C*246
C5=C*678
C6=C*268
N1=N4-1
UEIN1=UE(N1)+(STRAN-XTEMP(N1))/((XTEMP(N1+1)-XTEMP(N1))*(UE(N1+1)-
LUE(N1))
IF(CLD=TTA(N1)
      XCLOC=XTEMP(N1)
      WHOLE=LE(N1)
      MHOLC=MTEMP(N1)
      TTA(N1)=THETAI
      XTEMP(N1)=XINI
      UE(N1)=UEINI
      MTEMP(N1)=AME
      HMEAN(N1)=HINIT
      HMEAN(N1)=1.269*HMEAN(N1)/(HMEAN(N1)-.379)
      XNUX1=(1.+C*2*XME**2)*#1.75*VO
      E1=3.*2.*C2
      E2=1.*+C2
      E3=3.*+3.*C2
      T1=0.*02*C1/C3*E2
      IEEG=N1+1
      DC 100 I=IBEG,NP
      JSAVE=I
      HMEAN(I)=0.0
      HMEAN(I)=C.0
      XNUX2=(1.+0.*2*MTEMP(I)**2)**1.75*VO
      IF(I.EQ.NP) GO TO 1
      280C000C0
      279900000
      2795000C0
      279400000
      2793000C0
      279200000
      279000000
      2788000C0
      278600000
      278400000
      278300000
      278200000
      278100000
      278000000
      277900000
      277800000
      277700000
      277600000
      277500000
      277400000
      277300000
      2772000C0
      277100000
      277000000
      276900000
      2768000C0
      276700000
      2766000C0
      276500000
      276400000
      2763000C0
      276200000
      276100000
      276000000
      275900000
      2758C000C0
      275900000
      276000000
      276100000
      276200000
      2763000C0
      276400000
      276500000
      2766000C0
      276700000
      2768000C0
      276900000
      277000000
      277100000
      2772000C0
      277300000
      277400000
      277500000
      277600000
      277700000
      277800000
      277900000
      278000000
      278100000
      278200000
      278300000
      278400000
      2785000C0
      278600000
      2787000C0
      2788000C0
      278900000
      279000000
      279100000
      279200000
      2793000C0
      279400000
      2795000C0
      279600000
      279700000
      2798000C0
      279900000
      2800C000C0

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```

DUEDX=((UE(I)-UE(I-1)) / (XTEMP(I)-XTEMP(I-1))+(UE(I+1)-UE(I))/
1(XTEMP(I+1)-XTEMP(I))) *0.5
1
CCNTINUE
      LET= (UE(I-1)/UE(I))**E3
      UEINI=0.5*(XTEMP(I)-XTEMP(I-1))*(UE(I)**E1+UE(I-1)**E1)
      TTA(I)= (TTA(I-1)**E2*UE(I*(XNUX2/XNUX1)**C2+T1*XNUX2**C2/
1*(UE(I)**E3)*UEINT)**(I-E2)
      TERM= (0.02*C1)/(UE(I)*TTA(I)/XNUX2)**C2*I.1
      T2=TTA(I)/UE(I)*DUEDX
      H=H-MEAN(I-1)
      HV=HMEAN(I-1)
      DC 110 J=1,NI
      TERM3 = -HV*C4*10.0.C**(-C5*H)*(UE(I)* TTA(I)/XNU2)**(-C6)
      TERM= TERM3 /2
      TERM= (H-1.1)*HV*T2
      DHVDX=(TERM+TERM3/TERMC)/TTA(I-1)
      HVITR = HVMEAN(I-1)+DHVDX*(XTEMP(I)-XTEMP(I-1))
      IF(HVITR-1.85)202,201,201
201   HVITR = 1.65
202   IF(HVITR-1.55)203,203,204
2C3   HVITR = 1.55
204   CCNTINUE
      HITR = C.379*HVITR/(HVITR-1.269)
      HVMEAN(I)=HVMEAN(I)+HVITR
      HMEAN(I)= HMEAN(I)+HITR
      HV=HVITR
      H =HITR
      CCNTINUE
110   CCNTINUE
C
      HVMEAN(I)=HVMEAN(I)/NI
      HMEAN(I)=HMEAN(I) /NI
      DSTR(I) =TTA(I)*HMEAN(I)
      DEL(I) =(TTA(I)*HMEAN(I)*(HMEAN(I)+1.0))/(HMEAN(I)-1.)
      DEL2(I) =.OC0457+.13*.89*TTA(I)+191.64*TTA(I)**2
      CFLOC(I) =C4*10.0*(-C5*HMEAN(I))*(UE(I)*TTA(I)/XNU2)**(-C6)
      XNUX1=XNUX2
      XCC =X(I)/CREF
      SCC =XTEMP(I)/CREF
      DDX=DMDS(I)*CREF
      Th =TTA(I)/CREF
      DEL =DSTR(I)/CREF
      DELT=DEL(I)/CREF
      WRITE(I,1004)XOC, SOC,MTEMP(I),DMDX,HMEAN(I),TH,DEL,DELT,CFLOC(I)

```

```

1CC4 FORMAT(1H ,F1C.6,2A,S(1X,F12.6))
30  CCN1NUC
   IF( SEND-XTEMP(I))IC,1C,1C0
1CC  CCN1NUC
10  CCN1NUC
DC 15 I=IBEG,JSAVE
IA=ITEMP(1)
DLIAS(IA)=DSTR(1)
15  CFI(IA)=CFLOC(1)
DLIA(IC,JS)=DELI(JSAVE)
ITTA(IC,JS)=TTA(JSAVE)
C  RETURN N1 ELEMENTS TO THEIR ARRAYS
TTA(N1)=THCLD
ITEMF(N1)=XHOLD
UEIN1)=UHOLD
ITEMF(N1)=PHOLD
RETURN
END

```

28440000
28450000
28460000
28470000
28480000
28490000
28500000
28510000
28520000
28530000
28540000
28550000
28560000
28570000
28580000
28590000
28600000
28610000

```

SUBROUTINE TURB(HSEEF,NP,IC,JS,JN,ISEP,SEND)
  DOUBLE PRECISION A(4)
  CCWMCN NXLCITH(4,2),NXUPTH(4,2),CH(4),XCT(165),ZCT(165),
  1H ETAA(105),IS(165),XPCT(165),2PCT(165),NC,TITLE(8),ALFA,FSMCH,ML(165),
  2V(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),ISTAG(4),SSTAG(4),
  3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),P,TJ,REN,PRR,XK,NCU,IPLOT,
  4CF(165),DLTAS(165),CREF,THICK(165),GVBT(165),VBTF(165),
  5DLTASP(165),GVBL(165),VVBD(165),VVBDP(165),VNBDP(165),CN(4,10),
  6MAP,CK(5,3,2),XIST(3,2),XFST(3,2),FF(3,2),
  7,ISLCT(3)
  CCWMCN/VISCOUS/ SUMS(65),AME(65),SLU(65),UE(65),UEI(65),
  1DDOMDS(65),XX(65),ISLRF,ITEMP(65),ZTEMP(65)
  CCWMCN/TURBTR/SCRIT,RECIT,STRAN,RTRAN,THETA1,SCSEP,LSEP,
  1HINI,N4,CFTRA,CFF(65),AMETR,SLOTR
  CCWMCN/CNFLTR/DLTA(4,2),HTA(4,2)
  CCWMCN/PLBLK/DELS
  DIMENSION X(100),CPI(100),DELTAS(100),DELSTS(100),GFS(100),
  1THEtas(100),HS(100),TA(65),DELS(65),OLA(65),HH(65)
  REAL M,MINF,MCM(100),KE(100)
  DIMENSION BLSEG(2)
  DATA LFILE/3HLGO/
  DATA PI/3.1415927/,
```

C INTEGRAL METHOD FOR 2 D OR A S COMPRESSIBLE FLOW (ER 9428)

C L=6

```

  NINF=NP
  MINF=FSMCH
  HSI=2.0
  IF(MINF-.01)10,10,20
  1C MINF=.01
  2C CCNTINLE
  WRITE(L,1001) TITLE,ISURF,IC,JN
  1COC FCRTMA(30H STAGNATION TEMPERATURE
  11.6HDEGREES RANKINE
  19X,2HSTAGNATION PRESSURE
  230H FREESTREAM MACH NUMBER
  = ,F11.3,5X,10H LB/SQ FT/
  = ,F12.5,2IX,1H,9X,13HAIRFOIL CHUR
  3D,16X,1H=.5X,F7.3,7X,2HFT/30H REYNOLDS NUMBER PER FOOT = ,F13.6,
  43X,7+ MILLION,10X,1H,9X,14HPRANDTL NUMBER,15X,1H=.7X,F6.4/
  523H HEAT TRANSFER FACTOR K,5X,1H=.F12.4,22X,1H,9X,
  621H TRANSITION POINT, S/C,8X,1H=.F14.5, /
```

286200000
286300000
286400000
286500000
286600000
286700000
286800000
286900000
287000000
287100000
287200000
287300000
287400000
287500000
287600000
287700000
287800000
287900000
288000000
288100000
288200000
288300000
288400000
288500000
288600000
288700000
288800000
288900000
289000000
289100000
289200000
289300000
289400000
289500000
289600000
289700000
289800000
289900000
290000000
290100000
290200000
290300000

```

734H (INITIAL MEMENTUM THICKNESS) /C = F8°5°21X,1H°,9X°
630H INIT. INCCMPR. FCRM FACTOR =,F14°5°16H ANGLE OF ATTACK,12X°
91H=,F12°4.5X,7H(GREES)
XLEN=CH(1C)
ANGL=ALFA*57.2557755
SEC=STRAN/CREF
TH=THETAL/CREF

WRITE(L,1000) TC,P,MINF,XLEN,REN,PRR,XK,SOC,TH,HINIT

1. ANGL
1CC1 FORMAT(1H1,30X,32H TURBULENT BOUNDARY LAYER SUMMARY//25X,8A10,5X
1. P6,7HSURFACE/1C7X,16HCOMPONENT NUMBER,13,/,/
2 107X,16HITERATION NUMBER,13,/,)
3C X(1)=STRAN
THETAL=THETA1
DELTA=6.*THETAL
THETAS(1)=THETA
HI=HINIT
DELTAS(1)=DELTA
CPI(1)=-1.
NS=C

DC 330 I=1,1C0
IF(I-1)90,50,40
4C DX=4.0*DELTA
IF(IDX-.1/(ABS(DXM)+C.00001))60,60,5C
5C DX=.1/ABS(DXM)
6C CCN1INUE
IF(DC)/XLEN-C3)EC,8C,70
7C DX=C.03*XLEN
EC X(I)=X(I-1)+DX
IF(X(I)-SEND) 9C,336,336
9C CALL POINT(SUN$,$,AME,X(I),M,1,NP,A)
CALL SLOPE(X(I),P,DXM)
IF(M-.01)110C,110,110
10C M=.01
110 CCN1INUE
T=(1.+0.2*MINF**2)/(1.+0.2*M**2)
U=M/MINF*SQRT(T)
DL=DXM/(M*(1.+0.2*M**2))
FM=1./(1.+C.178*M**2)
120 Q=U**2*T**2.5
RE=1(CC0C00-*FM*KEN*L/Q*T**1.74
HLI=1.

```

```

130 IF(I=1)I30,I30,I40
130 MCM(I)=C*THETA
H3=2.-(C.8-0.651/HI-0.149/HI**2)/(1.+0.C135*M**2)
KE(I)=MCM(I)*H3*U
C
140 DC 300 K=1,2
IF(I=1)190,190,150
150 MCM(I)=MUM(I-1)+C.5*(UM+DMN)*DX
KE(I)=KE(I-1)+0.5*(CK+UKK)*DX
CPI(I)=CPI(I-1)+0.5*(UC+DCC)*DX
DELH3=(2.-KE(I))/MCM(I)/U)*(1.+0.0135*M**2)
HI=1.+1.33333*DELH3+12.*DELH3**4
IF(HI-HSEP)190,19C,160
16C HI=HSEP
170 NS=NS+1
IF(NS=1) 180,18C,210
18C SSEP=X(I)
GCIC 210
190 IF(HI-1.CI)200,210,210
20C HI=1.01
210 CCNTINUE
H=HI*(1.+0.135*M**2)+0.228*M**2
220 H4=(C.0655/(HI-0.5)+0.238)*M**2
FEAR=1./HI-C.4
CF=FN*FEAR/(3.18*ALCG10(ABS(MOM(I)*RE))-1.)*2
230 CPH=-0.C08833+0.C278C5*HI-0.034881*HI**2+0.C19496*HI**3
1-C.C3589*HI**4
IF(CFI(I))240,25C,250
240 CFI(I)=CPH
250 DM=0.5*Q*CF-MCM(I)*H*DU
DK=C*(CPI(I)+0.5*CF)*J-2.*MCM(I)*U*H4*DU
CCNST=4.
IF(CFH-CPI(I))26C,270,270
260 CCNST=1C.
27C DELTA=5.882*ABS(MCM(I))/Q*(1.+1*M**2)/(1.-EXP(-3.5*(HI-1.)))
DC=CCNST/DELTACPI(I)*(SQRT(CPH)-SQRT(CPI(I)))
IF(I-1)310,310,28C
280 IF(AES(1.-LI/HI)-C.C005)310,31C,290
290 HLJ=H
300 CCNTINUE
DX=0.5*DX
GCIC 80
C

```

```

210 DAN=CV
JSAVE=1
DKK=DK
ECC=DC
TETA=MCM(I)/Q
DELS1=THETA*H
THETAS(I)=THETA
DELTS(I)=DELST
HS(I)=H
CFS(I)=CF
DELIAS(I)=DELTIA
320 IF(X(I)-SEND) 320,320,336
330 CCNTINUE
336 CCNTINUE
NINP=JSAVE
IF(JN=4) 331,331,34C
331 IF(N=-1)340,332,332
332 CALL PCINT(X,HS,SSEF,DUM,1,NINP,A)
C 340 CCNTINUE
WRITE(1,10C2)
10C2 FCRMAT(1HC,4X,3HX/C,15X,3HS/C,9X,1HM,8X,8HD//S/C),7X,1HH,12X,
17HTHETA/C,5X,6HDELS/C,6X,7HDELTA/C,6X,2HCF/)
DPRN=THETA1*HINIT/CREF
XTR=XTTRAN(IC,JS)/CREF
STR=STRAN/CREF
DUDS=SLCTR*CREF
TH=THETA1/CREF
WRITE(1,1003)XTR,STR,AMETR,UMDS,HINIT,TH,DPRN,
1 CFTRA
10C3 FCRMAT(1H,F10.6,2X,6F13.6,F13.6)
DC 380 I=N4,NP
CALL POINT(X,THETAS,SUMS(I),TTA(I),1,NINP,A)
CALL PUNI(X,DELS1,SUMS(I),DELS(I),1,NINP,A)
CALL POINT(X,HS,SUMS(I),HH(I),1,NINP,A)
IF(H(I)-1.15) 360,350,350
350 DLA(I)=TTA(I)*HH(I)*(HH(I)+1.0)/(HH(I)-1.0)
GC TO 370
360 DLA(I)=0.0C0497+13.89*TTA(I)+191.64*TTA(I)*#2
370 CCNTINUE
CALL POINT(X,CFS,SURS(I),CFF(I),1,NINP,A)
XCC=X(I)/CREF
SGC=SUMS(I)/CREF

```

```

DMDS=SLU(I)*CREF
TH=TTA(I)/CREF
DEL=DELS(I)/CREF
DELT=DLA(I)/CREF
WRITE(1,13C4)XCC,SCC,AME(I),DMDS,HH(I),TH,DEL,DELT,CfF(I)
1CC4 FORMAT(1H,FI0.6,2X,SIX,F12.6)
IA=ITEMP(I)
DLIAS(IA)=DELS(I)
CFI((IA)=CFF(I)
IF(SUMS(I)-SEND) 380,385,385
385 CONTINUE
395 CALL POINT(SUMS,ITA,SEND,THA(IC,JS),N4,NP,A)
CALL POINT(SUMS,CLA,SEND,DLTA(IC,JS),N4,NP,A)
IF(N5-1)40C,390,39C
39C CALL POINT(SUMS,XX,SEP,XSEP,L,NINP,A)
XSEP=XSEP/CREF
SSEP=SSEP/CREF
WRITE(L,10C5)XSEP,SSEP
ISEP=ISEP+1
1CC5 FORMAT(36HC SEPARATION HAS OCCURRED AT X/C =,F11.6,8X,
15F5/C =,F11.6)
4CC CONTINUE
IFI(IFLCI.LE.0) RETURN
C BLSEC(I)=4FSECS
C BLSEC(2)=0
C CALL SEGMENT(LFILE,2,BLSEG,O,MAP)
C CALL PLOTBL(XX(3),TT(3),DELS(3),NP-2,TITLE,CREF,MINF,ANGL,
C IUS,IC)
C RETURN
END

```

```

SUBROUTINE CONF5( IC78,CFD3,CFD2,IC,J5 )
C GRADIA'S COMPUTATIONAL METHOD FOR CONFLUENT BOUNDARY LAYER
C IN THE CORE REGION
C
C CONF5 = COMBINED CUNF2 AND CONF6
C
CCMNCN/NXLOTH(4,2),NXUPTH(4,2),C(4),XCT(165),ZCT(165),THETA(165),
IS(165),XPCT(165),ZPCT(165),NC,TITLE(8),ALFA,FSMCH,YUV(165),
2VI(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),TSTAG(4),SSTAG(4),
3LIRAN(4,2),XTKAN(4,2),ZTKAN(4,2),PO,TO,RN,PR,KF,NCU,PLTT,
4CFI(165),DLTAS(165),CREF,THCK(165),GVBT(165),VVBT(165),
5DLIASP(165),GVBD(165),VVBDP(165),VVBDP(165),CN(4,10),
6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2),
7ISLO1(3),
CCMNCN/TEMP/UC(65),EJAVE(65),THAVE(65),HAVE(65),UWAVE(65),
IBAVE(65),CLAVE(65),D2SAVE(65),REAVE(65),TWAVE(65),DSTAVE(65),
2D4DAVE(65),HWAVE(65),HVFAVE(65),UWAVE(65)
3.DLS1AV(65),CFIP(65)
CCMNCN/VISCUS/STEMP(65),NTEMP(65),DMDS(65),UE(65),DUEDS(65),
1DCMDS(65),X(65),ISURF,ITEMP(65),ZTEMP(65),XM(65)
CCMNCN/CNFLTR/CLTA(4,2),HTA(4,2)
CCMNCN/INIT/XINI,NF,NI,N1,XMINF,AO,UEG,XMG,CEL12,THETA2,XMU,PU,
ITINF,DELI,DELE,TEFH,BJI,BWI,FISQ,F2SQ,FIE,THI,THE,XH,
2DEL5,UINF,RO,XNU,R1E3TH,SK1
CCMNCN/CONST/S2M3,S2M4,S2M5,C5,C5INI,SM1,SM2,C23,C24,C25,C26,
IC11,C12,C13,C14,C15,C16,A1,G1,G2
DIMENSIGN CFD3(65),CFD2(65),D2AVE(65),DSTAVE(65),DISAVE(65),
IC3AVE(65),E4AVE(65),Y1CAVE(65)
M=6
      WRITE(M,2001)
2001  FCNTRAT(IX+1)HCURE REGION//)
NB=N1
IC78=0
C21=1.712
C22=-.0CCC5
C1=.4
C2=.1
G3=3.0
U1AVE(N1)=0.
E2AVE(N1)=0.
CLAVE(N1)=0.
THAVE(N1)=0.

```

```

HAVE(N1) = 0.
REAVE(N1) = 0.
THAVE(N1) = 0.
DTHAVE(N1) = 0.
D4AVE(N1) = 0.
H4AVE(N1) = 0.
HVAVE(N1) = 0.
D2SAVE(N1)=0.
DSTHAV(N1)=0.
BJAVE(N1)=BJI
DLSTHAV(N1)=0.

C STARTER VALUE OF UW/UE AT STATION 1 FOR JET AND WAKE LAYER
A2=A1*(DELI/XM(N1)**2+DELE)+0.5*TETH
A3=0.316*DELETE+C.316*DELI
A4=.182*DELETE+.182*DELI/XM(N1)
A5=-A2+.134*(DELETE+DELI/XM(N1)**2)
UW11=(A4+SQRT(ABS(A4**2+4.0*A5*A3)))/(2.*A3)
UH11=UW11

C CALCULATIONS OF CONDITIONS FOR WALL LAYER AT THE INITIAL STATION
THETA=THETAA
THAVE(N1)=THAVE(N1)+THETAA
DELIAA=DELI2
DIAVE(N1)=DIAVE(N1)+DELIAA
D2STRR=C21*THETAA+C22
D2SAVE(N1)=D2SAVE(N1)+D2STRR
HV=D2STRR/THETAA
HVAVE(N1)=HVAVE(N1)+HV
HH=C23*HV V+C24
HAVE(N1)=HAVE(N1)+HH
RETH=UE(N1)/XM(N1)*THETAA/12.0/XNU
REAVE(N1)=REAVE(N1)+RETH
TERM=10.0*(-C12*HH)*RETH**(-C13)
TH1DC=C11*TERM
TH1AVE(N1)=TH1AVE(N1)+TH1DC
SHK2Z=C14/(RETH**C15)*2.0
TD12Z=C16*TERM#2.C
DX=X(N1+1)-X(N1)

```

C

```

STARTING VALUE OF WIDTH OF JET LAYER WAKE LAYER FOR STATION 2
BJIJ=BJI+C1*((1.0/XM(N1)-UW11)/(1./XM(N1)+UW11))*DX
BH1J=BWI+C2*((1.0/XM(N1)-UW11)/(1.+UW11))*DX
DUEDX=(UE(N1+1)-UE(N1))/DX
UEM2=(UE(N1+1)+UE(N1))*0.5/UE(N1+1)**2

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```

3149C0000
3150C0000
315100000
3152C0000
3153C0000
3154C0000
3155C0000
3156C0000
3157C0000
3158C0000
3159C0000
3160C0000
3161C0000
3162C0000
3163C0000
3164C0000
3165C0000
3166C0000
3167C0000
3168C0000
3169C0000
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3171C0000
3172C0000
3173C0000
3174C0000
3175C0000
3176C0000
3177C0000
3178C0000
3179C0000
3180C0000
3181C0000
3182C0000
3183C0000
3184C0000
3185C0000
3186C0000
3187C0000
3188C0000
3189C0000
3190C0000
319100000

UE12=UE(N1)**2/UE(N1+1)**2
BkAVE(N1+1)=Bw1J
BJAVE(N1+1)=BJ1J
Uk1AVE(N1+1)=C.
DStAVE(N1+1)=0.
U4AVE(N1+1)=0.
E2AVE(N1+1)=0.
DStkAV(N1+1)=0.

ITERATION FOR JET AND WAKE WIDTH AND UW AT STATION TWO
DC 20 J=1,N1
Bk2F2=Bw1J*f2SG
Bk2F2E=Bw1J*f2E
Bj2F1=Bj1J*f1Sj
Bj2F1E=Bj1J*f1E
A6=Bk2F2+Bj2F1
A7=2.*Bk2F2-3w2F2E+2.*Bj2F1/XM(N1+1)-Bj2F1E/XM(N1+1)
A71=(-Bk2F2E-XM(N1+1)*Bj2F1E)*UEM2*DUEDX*DX
A8=eW2F2E-eW2F2+Bj2F1E/XM(N1+1)**2-Bj2F1/XM(N1)**2
A81=(Bk2F2E+Bj2F1E)*UEM2*DUEDX*DX
A5=-THI*UE12/XM(N1+1)**2-THE*UE12-5*TETH*(UE(N1)**2+UE(N1)**2/
1XM(N1)**2)/(2.*UE(N1+1)**2)
A1C=1-CFD3(N1+1)+C-5*CFD2(N1+1)*DX
Uw1IJ=(A7+SQR(TABS(P7**2+4.*A6*(A8+A9+A10)))/(2.*A6))
Uk1AVE(N1+1)=Uk1AVE(N1+1)+Uw1IJ
Bw1J=Bw1+C2*(10.5*((1.-Uw1IJ)/(1.+Uw1IJ)+(1.-Uw1IJ)/(1.+Uw1IJ)))*UX
Bk2N1=Bw1J
BkAVE(N1+1)=BkAVE(N1+1)+Bw1J
Bj2N1=BJ1J
Bj1J=BJ1+C1*(.5*((1./XM(N1)-Uw1IJ)/(1./XM(N1)+Uw1IJ)+(1./XM(N1+1)-
1Uw1IJ)/(1./XM(N1+1)+Uw1IJ)))*DX
BJAVE(N1+1)=BJAVE(N1+1)+BJ1J
D21J=XH-DELI-BJ1J*(G1+G2*XW(N1+1)*Uw1IJ)
D2AVE(N1+1)=D2AVE(N1+1)+D2IJ
DSt1J=((XM(N1+1)-1.0)/XM(N1+1))*BJ1J+BJ1J*(1./XM(N1+1)-Uw1IJ)*FILE
DStAVE(N1+1)=DStAVE(N1+1)+DSt1J
DStw1J=(1.-Uw1IJ)*Bw1J*f2E
DStw2V(N1+1)=DStwAV(N1+1)+DStw1J
D4C3JJ=Bw1J*g3
D4DAVE(N1+1)=D4DAVE(N1+1)+D4D3JJ

CCN1INUE
C STORE LAST VALUES
C Uh1(i,N1) SAME AS Uhi(i,N1+1)
Uh11=Uw1IJ

```

```

SET
UW11=UW11(I,J)
BJ11=BJ(I,J)
BJ2N1=BJ(I,N1) = NEXT TO LAST ITERATION ON PREVIOUS I
BJ2N=BJ(I,N1+1) =LAST ITERATION ON PREVIOUS I

C
BJ2A=BJ11
BW2N=BW11
UW11=UW11J

C
N1=N1+1
BWAVE(N1+1)=BWAVE(N1+1)/N1
BJAVE(N1+1)=BJAVE(N1+1)/N1
UWAVE(N1+1)=UWAVE(N1+1)/N1
DSTAVE(N1+1)=DSTAVE(N1+1)/(N1-1)
DSTWAV(N1+1)=DSTWAV(N1+1)/N1
D4AVE(N1+1)=D4AVE(N1+1)/N1
D2AVE(N1+1)=D2AVE(N1+1)/N1
CALCULATIONS OF THE CORE REGION WALL LAYER DOWN STREAM OF POINT 1
UTERN=(UE(N1+1)-UE(N1))*2.0/(UE(N1+1)+UE(N1))*THETA
PRT1=UTERM*(2.+HH)
PRT2=3.*UTERN*HW
C CALCULATIONS FOR JET + WAKE LAYERS PARAMETERS FROM POINT 3
DCWNSTREAM IN THE CCRE REGION
N1=N1+1
DC 402 I=N11,NP
JSAT=I
DX=X(I)-X(I-1)
DUECX=(UE(I)-UE(I-1))/DX
TERM=(UE(I)+UE(I-1))*5./UE(I)**2*DUECX*DX
UTERM=(UE(I-1)*2./UE(I)**2)
UTERN=(UE(I)-UE(I-1)*2.0/(UE(I)+UE(I-1))
T+ETAI=THETA-PR11+TWIDD*DX
IF(T+ETAI)<0,90,91
THETAI=THETA*I*1.67*(UE(I-1)/UE(I))*3.51+C.0077*XNU**0.167/2.
90 1*DX*(UE(I-1)**3.34+UE(I)**3.34)/UE(I)**3.51
THETAI=THETAI**((1./I*167)
CONTINUE
D2STR1=D2STRR-PH22*SWK22*DX-TD122*DX
HVF1=D2STR1/I*ETAI
IF(HVFO1-1.75)135,126,136
136 HV1=1.75
      GG TO 137

```

```

135 IF(HVFI=1.7)138,138,139
136 HVFI=1.7
137 GC TO 137
138 HVFI=FVFOI
139 CCN INUE
137 CCN INUE
HV=C23*HVII+C24
RET-I=UE(I)/XM(I)*IFETAI/12.0/XNU
DELTAI=C25+C26*I*ETAI
HVFAVE(I)=HVFOI
HHAVE(I)=I*ETAI
D2SAVE(I)=C23TRI
HVAVE(I)=HVII
HAVE(I)=HI
REAVE(I)=RETHI
LLAVE(I)=DELTAI
THAVE(I)=C.
DISAVE(I)=C.
IF(I.EQ.N11) GC TO 401
BJIJ=BjJ2N+C1*((1./XM(I-1)-UW11)/(1.+UW11))*DX
BKIJ=BW2N+C2*((1.-UkIJ)/(1.+UW11))*DX
BJAVE(I)=BJIJ
BwAVE(I)=BWIJ
UkAVE(I)=C.
C2AVE(I)=C.
DSTAVE(I)=C.
DST*AV(I)=C.
D4DAVE(I)=C.
DC 30 J=1,NI
BJJ =BJIJ
BWW =BWIJ
Bw2F2=BWIJ*F2SQ
Bw2F2E=BWIJ*F2E
BJ2F1 =BJIJ*F1SQ
BJ2F1E=BJIJ*F1E
A11=BW2F2+BJ2FL
A12=2.*BW2F2-BW2F2E+2.*BJ2F1/XM(I)-BJ2F1E/XM(I)
A121=-TERM *BW2F2E-(XM(I)+XM(I-1))*5*TERM*BJ2F1E
A13 =BW2F2E-BW2F2+BJ2F1E/XM(I)**2-BJ2F1/XM(I)**2
A131=BW2F2E*TERM+EJZFL*TERM
A14 =-UETERM*BjJ2N*(XM(I-1)**2)*(1.-XM(I-1)**2)*F2E+UETERM*BW2N*(1.-UW11)**2)*F2SQ-
1UETERM*BjJ2N/(XM(I-1)**2)*(1.-XM(I-1)*UW11)*F1E+UETERM*BjJ2N/
2XM(I-1)**2*((1.-XM(I-1)*UW11)**2)*F1SQ
A15=-(CFD3(I)-.5*CFD2(I))*DX

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332000000

UW1IJ=(A12+SQR((ABS(A12**2+.4*A11*(A13+A14+A15))))) / (2.*A11)
UW1AVE(1)=UW1AVE(1)+UW1IJ
BJ1J=BJ2N+C1*((1./XM(I-1)-UW1IJ)/(1./XM(I-1)+UW1IJ)+(1./XM(I))-UW1IJ)
1/(1./XM(I)+UW1IJ))*5*Dx
BJAVE(I)=BJAVE(I)+BJIJ
BW1J=BW2N+C2*((1.-UW1I)/(1.+UW1I)+(1.-UW1IJ)/(1.+UW1IJ))*5*Dx
BjAVE(I)=BjAVE(I)+BjIJ
D2IJ=XH-DEL1-BJ1J*(GL+G2*XM(I))*UW1IJ
D2AVE(I)=C2AVE(I)+C2IJ
DST1IJ=((XM(I)-1.)/XM(I))*B1IJ+B1IJ*(1./XM(I))-UW1IJ)*FILE
DSTAVE(I)=CSTAVE(I)+DST1IJ
DSTWIJ=(1.-UW1IJ)*BW1IJ*F2E
DSTWAV(I)=DSTWAV(I)+DSTWIJ
D4D2IJ=EW1IJ*G3
D4DAVE(I)=C4DAVE(I)+D4D3IJ
D4DAVE(I)=C4DAVE(I)+D4D3IJ
CCNTINUE
SAVE NI
BJ2NI=BJJ
BJ2N=BJW
UW1I=UW1IJ
SAVE NI+1
BJ2N=BJIJ
BW2N=BW1J
UW1AVE(I)=UW1AVE(I)/NI
C2AVE(I)=C2AVE(I)/NI
DSTAVE(I)=DSTAVE(I)/NI
DSTWAV(I)=DSTWAV(I)/NI
D4DAVE(I)=C4DAVE(I)/NI
BjAVE(I)=BjAVE(I)/NI
BjAVE(I)=BJAVE(I)/NI
CCNTINUE
UEMEAN=(UE(I)+UE(I-1))*0.5
DC 121 J=2,NI
HMEAN=(HH+H1)*C.5
REMEAN=(RETHH+RETH1)*0.5
TMEAN=(THETA+THETA1)*0.5
HMEAN=(HVV+HVI)*0.5
TERM=10.0**(-C12*TMEAN)
401
C D2STR,THEAA,RETH,HH,HVV=LAST ITERATION ON PREVIOUS I
C
C TWTDL=ALOG(C11)+ALOG(TERM)-C13*ALOG(REMEAN)
C TWDCL=EXP(TWTDL)

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3321C0000
3322C0000
332300000
3324C0000
332500000
3326C0000
3327C0000
3328C0000
332900000
333CC0000
333100000
3332C00C0
3333C0000
3334C00C0
3335C0000
3336000C0
3337C0000
333800000
333900000
334000000
3341C0000
334200000
334300000
334400000
334500000
334600000
334760000
334800000
334900000
335CC0000
335100000
3352C0000
335300000
335400000
3355000C0
335600000
335700000
335800000
3359C0000
336000000
336100000
336200000
336300000

THTAVE(1)=HTAVE(1)+HTLUD
SAK22=2.0*C14/RMEAN**C15
TCL22=2.0*C16*IERM*RMEAN**(-C13)
PRT11=UTER*IERM*(2.0+RMEAN)
PRT22=3.0*IERM*TMEAN*RMEAN
HTETAI=HTLUD*UX-PR11+THETA
IF(HTETAI)<3.93,S4
93   THETA=THETA**1.167*(UE(1)/UE(1))**3.51+C*0.0777*XNU**0.167/2.
     *DX*(UE(1-1)**3.34+UE(1)**3.34)/UE(1)**3.51
     THETA=THETA**((1./1.167))

94   CONTINUE
     THAVE(1)=THAVE(1)+HTETAI
     D2STRI=SWK22*DX-IC12*UX-PKT22+U2SIRR
     D2SAVE(1)=D2SAVE(1)+D2STRI
     HVFOI=D2STRI/HTETAI
     IF(HVFOI-1.75)<140,141,141
     HVFI=1.75
141   GC TO 142
     IF(HVFOI-1.7)<143,143,144
     HVFI=1.7
143   GC TO 142
144   HVFI=HVFOI
142   CONTINUE
     HI=C23*HVFI+C24
     HVFAVE(1)=HVFAVE(1)+HVFOI
     HVAVE(1)=HVAVE(1)+HVFI
     HAVE(1)=HAVE(1)+FI
     DISIRI=THETAI*HI
     DISAVE(1)=DISAVE(1)+DISTRI
     DELTAI=C25+C26*TETAI
     DLAVE(1)=DLAVE(1)+DELTAI
     REIHI=UE(1)/XM(1)*TETAI/12.0/XNU
     REAVE(1)=REAVE(1)+RETHI
     CONTINUE
131   HTAVE(1)=HTAVE(1)/(NI-1)
     THAVE(1)=THAVE(1)/NI
     D2SAVE(1)=D2SAVE(1)/NI
     HVFAVE(1)=HVFAVE(1)/NI
     HVAVE(1)=HVAVE(1)/NI
     HAVE(1)=HAVE(1)/NI
     CLAVE(1)=CLAVE(1)/NI
     REAVE(1)=REAVE(1)/NI
     DISAVE(1)=DISAVE(1)/(NI-1)

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DLSIAV(I)=(U1SAVE(I)+DSTAVE(I)+DSTWAV(I))
CFIP(I)=0.246#10.*#(-0.4C68*HAVE(I))*REAVE(I)*#(-0.268)
1/(UE(I)/UC(I))**2
D2STAR=D2STAR
THEIAA=THEIAA
DAVE(I+1)=DAVE(I+1)/NI
H#=H#
HV=HVI
IF(I.EG.N1) GU IC 402
IF(DLAVE(I)-C2AVE(I))402,404,404
CALCULATE VALUES FOR CLNF7 GR CCNF8
STCP 1 LLOOP
404 IF(DLAVE(I)-C.99)4C5,405,406
SET IC78=1, TO CALL CCNF7
405 IC78= 1
GC TO 4C7
SET IC78=2, TO CALL CCNF8
C 406 IC78= 2
GC TO 4C7
402 CCNTINL
407 CCNTINUE
IF(JSAVE.GE.NP) IC78=0
N1=JSAVE-1
UC(N1)=UC(N1)/UE(N1)
UC(N1+1)=UC(N1+1)/UE(N1+1)
E4AVF(NB)=0.
NB=NB+1
DC 519 I=NBP.JSAVE
E3AVE(I)=BJAVE(I)+E2AVE(I)
E4AVE(I)=D3AVE(I)+E4DAVE(I)
Y1CAVE(I)=D3AVE(I)+E4AVE(I)
519 CCNTINL
DC 520 I=NBP.JSAVE
XCC=X(I)/CREF/12.
SSC=STEMP(I)/CREF
DMDSCC=CREF*DMDS(I)
TCC=1HAVE(I)/CREF/12.
DELSGC=DLSIAV(I)/CREF/12.
DGC=D4AVE(I)/CREF/12.
520 WRITE(M,20C2) XUC, SCC, MTEMP(I), DMDSOC, HAVE(I), TOC, DELSUC, DCC
20C2 FFORMAT(1H ,8FI3.6)
WRITE(M,20C3)
20C3 FFORMAT( // )

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DLIA(IC,JS)=D4AVE(JSAVE)/12.
THIA(IC,JS)=(2.0/(HAVE(JSAVE)+1.0)-1.0/HAVE(JSAVE))*DLIA(JSAVE)
1+C.*4.0*(1.0-LWAVE(JSAVE))/UC(JSAVE)*BJAVE(JSAVE)
2+C.*233*(1.0-UWAVE(JSAVE))/UC(JSAVE)**2*BJAVE(JSAVE)
3+1.23*(1.0-LWAVE(JSAVE))*EWAVE(JSAVE)
4-C.*8C*(1.0-LWAVE(JSAVE))*2*BWAVE(JSAVE)
THIA(IC,JS)=THIA(IC,JS)/12.
CALCLATE XINI
DX=X(NI+1)-X(NI)
DN1=(CLAVE(NI+1)-CLAVE(NI))/DX
DN2=(D2AVE(NI+1)-D2AVE(NI))/DX
XINI=(D2AVE(NI)-CLAVE(NI))/(DN1-DN2)+X(NI)
RETCRN
END

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C

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C          SUBROUTINE CUNF7( IC78, IC, JS )
C          GURACIAS COMPUTATION METHOD FOR CONFLUENT BOUNDARY LAYER IN THE
C          MAIN REGION BETWEEN STATIONS 2 + 3 (MAIN REGION I ONLY)
C
C          CCNMCN NKLUTH(4,2),NXUPTH(4,2),C(4),XCT(165),ZCT(165),THETA(165),
C          LS(165),XPCT(165),ZPC(165),NC,TITLE(8),ALFA,FSMCH,VOW(165),
C          2VI(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),SSTAG(4),
C          ZTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,IPLT,
C          4CFI(165),DLTAS(165),CREF,THCK(165),GVBT(165),VGBT(165),
C          SDLIASP(165),GVBL(165),VVBG(165),GVBDP(165),VVBDP(165),CN(4,10),
C          6MAP,CK(5,3,2),XIS(3,2),XFS(3,2),FF(3,2),ISLCT(3),
C          CCNMCN/TEMP/UAVE(65),BJAVE(65),THAVE(65),HAVE(65),UWAVE(65),
C          1BAVE(65),CLAVE(65),D2SAVE(65),REAVE(65),TWAVE(65),DSAVE(65),
C          2D4CAVE(65),HVAVE(65),HVFAVE(65),UWAVE(65)
C          3,DLSTAV(65),CFIP(65)
C          CCMMCN/VISCU3/STEMF(65),MTEMP(65),UMDS(65),UE(65),DUEDS(65),
C          1DEMDS(65),X(65),ISRF,ITEMP(65),ZTEMP(65),XM(65)
C          CCMMCN/CNFLTR/DLT(4,2),THA(4,2)
C          CCMMCN/INIT/XINI,NP,N1,XMINF,AO,UEG,XMG,DELI2,THETA2,XMU,PU,
C          ITINF,UELI,DELE,TEI,BJI,BWI,FISQ,F2SQ,FIE,Thi,THE,XH,
C          2DEL5,UINF,FO,XNU,R13TH,SK1
C          CCMMCN/CONST/SM3,SM4,SM5,C5INI,SM1,SM2,C23,C24,C25,C26,
C          LC11,C12,C13,C14,C15,C16,A1,G1,G2
C          DIMENSION D4AVE(65)
C          DATA RTD3TH/0.3/
C          M=6
C          NB=N+1
C          WRITE(M,20C1)
C          20C1 FORMAT(1X,13HMAIN REGION-I//)
C          N2=N+1
C          ISAVE=N1
C          C21=1.73
C          C22=-.CC0C5
C          C3=.17
C          C4=.185
C          C3INI=.17
C          C4INI=.185
C          IC78=0
C
C          CALCULATION OF CONDITION AT THE INITIAL STATION
C          DX= X(N2)-X(N1)
C          DUE = UE(N2)-UE(N1)/DX
C          UEINI= UUE*(XINI-X(N1))+UE(N1)

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DTIH = (THAVE(N2)-THAVE(N1))/DX
TH5INI = DTIH*(XINI-X(N1))+HAVE(N1)
DH = HAVE(N2)-HAVE(N1)/DX
DD2SCX=(D2SAVE(N2)-C2SAVE(N1))/DX
HINI = DH*(XINI-X(N1))+HAVE(N1)
DLW = (LWAVE(N2)-LWAVE(N1))/DX
DLW=DLIM(DLW)
UWINI=DUW*(XINI-X(N1))+UWAVE(N1)
LUN = (UMAVE(N2)-UMAVE(N1))/DX
DUM=LLIM(DUM)
UWINI = DUM*(XINI-X(N1))+UWAVE(N1)
LBJ = (BJAVE(N2)-BJAVE(N1))/DX
BJINI = DBJ*(XINI-X(N1))+BJAVE(N1)
DEW = (EWAVE(N2)-EWAVE(N1))/DX
BWINI=DEW*(XINI-X(N1))+EWAVE(N1)
DL5=(DLAVE(N2)-DLAVE(N1))/(X(N2)-X(N1))
DEL5=DL5*(XINI-X(N1))+CLAVE(N1)
D2SINI = C21*TH5INI+C22
HVFINI = D2SINI/TH5INI
IF(HVFINI-1.8) 20,21,21
HVINI=1.8
21 GC TO 22
20 IF(HVFINI-1.63) 23,23,25
23 HVINI=1.63
24 GC TO 22
25 HVINI=HVFINI
22 CCNINUE
HCINI=4.411-23.9/HVINI+33.11/HVINI**2
DISTR = TH5INI* HCINI
REINI = UMINI* UEINI * TH5INI / 12.0/ XNU
Y= ALDG(REINI)
XLIT2= ALOG(2*XLIT2)-.518*HCINI +17.21*Y -0.743*Y**2-45.79*ALOG(Y)
XLIT1=ALOG(1.964E16)-1.819*HCINI +35.68*Y-1.365*Y*Y-
1.114*6*ALOG(Y)
CF2BUM = EXP(XLT)
XLIT1=ALOG(1.616E23)- .636*HCINI +48.55*Y-1.82 *Y*Y-158.7
1*ALCG(Y)
SHRINT = EXP(XLT)
C
C REINI=RETH(N1,N1), ETC.= LAST ITERATION
C RETH1=RETH(I+1,J) OR RETH(I+1,J+1)
R1D51w=(CF2BUM-TwNITS)/CF2BUM

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IF(XINI-X(N1))<1C,6CC,610
  U1IJ=UWINI
  GC TO 620
  CONTINUE
  U1IJ=UWINI+(UWINI-UWAVE(N1))/(XINI-X(N1))*(X(N1+1)-XINI)
  LEWDX=C4INI*(1.-UWAVE(N1))/(1.+UWAVE(N1))*5+.5*C4INI*
  1((1.-UWINI)/(1.+UWINI))
  DLWDX=DUW
  DLMDX=DLM
  UMIJ=UMINI+DUMDX*(X(N1+1)-XINI)
  CEJDX=C3INI*(UMINI-UWINI)/(UMINI+UWINI)*5+.5*C3INI*
  1((UMIJ-U1IJ)/(UMIJ+U1IJ))
  DTHDX=DTH
  DTHDX=DX
  SAVE
  XN1=X(N1)
  UE1=UE(N1)
  STORE N1 VALUES FOR X,UE. RESTURE AT END OF ROUTINE
  X(N1)=XINI
  UE(N1)=UEINI
  DX=X(N1+1)-X(N1)
  TH1J=TH5INI+DTHDX*DX
  DTDX=DH
  H1J=FCINI+DHDX*DX
  B1IJ=BJINI+CBJDX*DX
  BWIJ=BWINI+CBWDX*DX
  HVIJ=HVINI
  D1WAL=DELS
  NFM11=NP-1
  CF2BLM=CF2BUM*.45
  TWM15=TWM15*.55
  SFRIN1=SHRINT*.55
  DC 110 I=N1,NPM11
  JSAVE=I
  DUMCX=(CUMDX+DUM)/2.
  DEJCX=(EBJDX+DBJ)/2.
  DBwdx=(CBWCX+DBK)/2.
  DLSTAV(I+1)=0.
  UWAVE(I+1)=0.
  BJAVE(I+1)=0.
  THAVE(I+1)=0.
  HAVE(I+1)=0.
  UWAVE(I+1)=0.

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CLAVE(I+1) = 0.
BHAVE(I+1)=0.
REAVE(I+1)=U.
D4AVE(I+1)=0.
HVAVE(I+1)=0.
HVFAVE(I+1)=0.
D2SAVE(I+1)=0.
D4AVE(I+1)=0.

C WAKE LAYER CALCULATIONS
DLEDX = (UE(I+1)-UE(I)) / DX
UEMEAN = UE(I+1)*0.5+UE(I)*0.5
DC ICI J=1,NI
BMEAN=BWINI*.5+BWIJ*.5
UWINN=1.-UWINI*.5-UW1IJ*.5
UWMEAN=UWINI*.5+UW1IJ*.5
HMEAN=HINI*.5+HIJ*.5
BJMEAN=BJINI*.5+BJIJ*.5
HMEAN=H5INI*C.5+HIJ*.5
HTERN=(2.0*(0.5*HINI**2+C.5*HIJ**2)-5.0*HMEAN+1.0)
TIBW=SM1*UW1MN*CBWDX-SM2*UW1MN**2*DBWDX
TIPRES = 3.*SM1*UW1MN*BWMEEAN*DUEDX/UEMEAN
TIPRES = TIPRES+ 2.*UW1MN*1./UMMEAN*DUEDX/UEMEAN*TMEAN*HMEAN*
INTERV/(HMEAN-1.0)**2
22-SM2*UW1MN**2*BWMEEAN*2.0*DUEDX/UEMEAN
TIPRES = TIPRES+ EJMEAN*UW1MN*DUEDX*UMMEAN/UEMEAN
TIPRE1=-SM3*UW1MN*BJMEEAN*(UMMEAN-UW1NI*0.5-UW1IJ*0.5)
1*DUEDX/UEMEAN+2.*C*UW1MN*TMEAN*(HMEAN+1.0)/(HMEAN-1.0)**2*
2UMMEAN*DUEDX/UEMEAN
TIPRES = TIPRES + TIPRE1
TIBJEW=UW1MN*UMMEAN*CBJDX-SM3* UW1MN*(UMMEAN-UW1NI*.5-UW1IJ*.5)*
LDBJDX
TIBJLM=BJMEEAN*UW1MN*DUMDX-SM3*UW1MN*BJMEEAN*CUMDX+2.*UW1MN*TMEAN*
HMEAN*(HMEAN+1.0)/(HMEN-1.0)**2*DUMDX
TISKF = -4.*0.*UMMEAN*UW1MN*HMEAN**2 / (HMEAN-1.0)**2*CF2BUM -UMMEAN*
UW1MN*((5.*0.*HMEAN-1.0)/(HMEAN-1.0))*CF2BUM*RTD5TW -RTD3TW*CF2BUM*
2UMMEAN**2
TISHWK = UMMEAN*UW1MN*((3.*HMEAN-1.0)/(HMEAN-1.0)**2)*SHRINT
TIDENO = SM1*BWMEEAN - 2.0*SM2*BWMEEAN*UW1MN-SM3*UW1MN*BJMEEAN
DUW=(T1BW+TIPRES+TIBJEW+TIBJUM+TISKF+TISHWK)/TIDENO
DUW=CLIN(DUW)
DUW1CX=(DUW1DX+DUW)/2.
UW1IJ=UW1NI+DUW1DX*DX
DBw=C4/2.*((1.-UW1NI)/(1.+UW1IJ)+(1.-UW1IJ)/(1.+UW1IJ))

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C

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C EEWLX=(EBW+CBWDX)/2.
BWIJ=BNINI+CBWDX*DX
JET LAYER-CALCULATIONS
UW1N=UNI*C.5+UNIJ*0.5
BWMEAN=(BWINI+BWIJ)/2.
T2BJ=SM4*(UMMEAN-UW1N)*UMMEAN*DBJDX+SM3*(UMMEAN-UW1N)**2*
1CEJDGX-SM5*(UMMEAN-UW1N)**2*DBJDX
T2BJUN=SM4*BJMEAN*UW1N*DBJDX-1.0*SM3*BJMEAN*(UMMEAN-UW1N)*
1DUWICX+2.0*SM5*BJMEAN*(UMMEAN-UW1N)*DUWIDX-UrMEAN*BJMEAN*DUWIDX
T2SKF = 4.0 * UMMEAN*(UMMEAN-UW1N)*(HMEAN/(HMEAN-1.0))**2*
1CF2BLM +UMMEAN*(UMMEAN-UW1N)*(5.0 * HMEAN-1.0)*
2RTCDTW* CF2BUM + RTD3TW * CF2BUM*UMMEAN**2 -RTD5TW*CF2BUM#
SUMMEAN**2
T2PRES=-2.0*C*HMEAN/(HMEAN-1.0)**2)*HTERN*THMEAN*UMMEAN*(UMMEAN-
1UW1N)/UEMEAN*DUELX
T2PRES = T2PRES + DUEDX*BJMEAN/UEMEAN - SM4*UMMEAN*(UMMEAN-UW1N)*
1BJMEAN*2.0*DUEDX / LEMEAN
T2PRES = T2PRES + SM2*((UMMEAN-UW1N)**2)*BJMEAN*2.0*DUEDX/UEMEAN
T2PRE1 = -SM5*(UMMEAN-UW1N)**2*BJMEAN*2.0*DUEDX /UEMEAN
T2PRE1=T2PRE1-UMMEAN*BJMEAN*UW1N*DUEDX/UEMEAN
T2PRE1 = T2PRE1+SM2* BJMEAN*(UMMEAN-UW1N*DUEDX/UEMEAN
T2PRE1=T2PRE1-2.C/UEMEAN*(UMMEAN-UW1N)*THMEAN*UW1MN* UEDX
1.5+HMEAN)/(HMEAN-1.0)*2)*UMMEAN*DUEDX
T2PRES = T2PRES + T2PRE1
T2SHWK = -UMMEAN*(UMMEAN-UW1N)*((3.*UMMEAN-1.0)/(HMEAN-1.0))**2*
1SPRINT
T2DENJ = 2.0*BJMEAN*UMMEAN*SM4-SM4*BJMEAN*UW1MN-2.0*SM3*BJMEAN*
1((UMMEAN-UW1N)+2.0*SM5*BJMEAN*(UMMEAN-UW1N)+2.0*TMEAN*HMEAN*
2(HMEAN+1.0))/((HMEAN-1.0)**2)*(UMMEAN-UW1N)
DLN=(T2BJ+12BJUK+T2SKF+T2PRES+T2SHWK)/T2DENC
DLN=DLIN(DLN)
DUMCX=(DUM+DUMDX)/2.
UNIJ=UNINI+DUMDX*DX
DBJ=3/2.*((UNINI-UW1N)/(UNINI+UW1N)+(UNIJ-UW1J))/(UNIJ+UW1J)
DBJDX=(EBJ+DBJDX)/2.
BBIJ=BJINI+DBJDX*DX
UAMEAN=UNINI*0.5+UNIJ*0.5
BJMEAN=BJINI*0.5+BJIJ*0.5
WALL LAYER MOMENTUM INTEGRAL EQUATION
T3THUM=2.0*TMEAN/(HMEAN-1.0)*DUMDX/UMMEAN
T3PRES = 2*TMEAN/(HMEAN-1.0)*DUEDX/UEMEAN -(1.0/UMMEAN**2)/
1UEMEAN*DUEDX*HMEAN*(HMEAN+1.0)/(HMEAN-1.0)* THMEAN
T3SKF = THMITS

```

```

DTIM=(T3THUM+T3PRES+T3SKF)
DTHDX=(DTH+DTHDX)/2.
DTHGX=DTLIM(DTHDX)
THIJ =TH5INI+DTHDX*DX
C    WALL LAYER ENERGY INTEGRAL EQUN.
HMEAN=HV1J*.5+HV1J*.5
THMEAN=TH5INI*.5+TH1J*.5
HVULM=-3.*THMEAN*HVMEAN/UMMEAN*DUMUX+2.*THMEAN*HVMEAN/(2.*HVMEAN
1)*DUMDX/UMMEAN
T4PRES = -3.*THMEAN*HVMEAN/UMMEAN*DUEDX +2.*C*THMEAN*HVMEAN/(2.*-
HVMEAN)/UEMEAN*DUEDX -2.*C*THMEAN*HVMEAN/(2.*C-HVMEAN)/( UMMEAN**2) /
2*UMMEAN*DUEDX
T4SHFK = 2.*0.* SHINT
T4SKF =-2.*0.* RTC5TW * CF2BUM
DD2SX=(T4HVUM+T4PRES+T4SHFK+T4SKF)
DC2SX=(DD2S+DD2SDX)/2.
U2SIJ = U2SINI+U02SE*X*DX
HVFGI = D2SIJ/THIJ
IF(HVFOI-1.8)>300,2C1,301
 3C1  HV1J=1.8
  GC 1C 302
  3C0  IF(HVFOI-1.63)>303,303,305
  3C3  HV1J=1.63
  GC 10 302
  3C5  HV1J=HVFOI
  3C2  CCNTINUE
  HV1J=16.133-56.91/HV1J+54.54/HV1J**2
  RETHJ=U1IJ*UE(I+1)*(THIJ/12.0)/XNU
  Y=ALCGIREINI*0.5+REIHIJ*C.5)
  HMEAN=HINI*.5+HV1J*.5
  XLT=ALOG(1.964E16)-1.819*HMEAN+35.68*Y-1.365*Y*Y-114.6*ALOG(Y)
  CF2BUM=EXP(XLT)
  XLT2=ALOG(2.518)-.518*HMEAN+17.21*Y-.743*Y**2-45.79*ALOG(Y)
  TnNIT5=EXP(XLT2)
  XLT1=ALOG(1.616E23)-.636*HMEAN+48.55*Y-1.82*Y*Y-158.7*ALOG(Y)
  SHINT=EXP(XLT1)
  RID5TW=(CF2BUM-TnNIT5)/CF2BUM
  DIWAL=.00434+9.492*THIJ
  DSTRL=THIJ*HIJ
  DSTRJI=B1IJ*I!.-U1IJ)+B1IJ*(U1IJ-U1IJ)*SM3
  DSTRWK=(1.0-U1IJ)*B1IJ*SM1
  D4MIC3=SK1*B1IJ
  DLSIAV(I+1)=DLSTAV(I+1)*DSTRWL+DSTRJT+DSTRWK

```

```

UMAVE(I+1)=UMAVE(I+1)+UMIJ
BJAVE(I+1)=BJAVE(I+1)+BJIJ
THAVE(I+1)=THAVE(I+1)+THIJ
HAVE(I+1)=HAVE(I+1)+HIJ
UWAVE(I+1)=UWAVE(I+1)+UWIJ
CLAVE(I+1)=CLAVE(I+1)+DIWAL
BWAVE(I+1)=BWAVE(I+1)+BWIJ
REAVE(I+1)=REAVE(I+1)+RETHIJ
D4AVE(I+1)=D4AVE(I+1)+D4MID3
HWAVE(I+1)=HWAVE(I+1)+HVIJ
HVAVE(I+1)=HVAVE(I+1)+HVFOI
D2SAVE(I+1)=D2SAVE(I+1)+C2SIJ
CF2BUM=CF2BUM*.48
TWM115=TWM115*.55
SHRINT=SHRINT*.55
D2=C1WAL+BJIJ
D3=C2+BWIJ
D4=D2+D4MIC3
C4AVE(I+1)=C4AVE(I+1)+D4
CONTINUE
REINI=RETHIJ
T+5INI=THIJ
HVINI=HVIJ
D2SINI=D2SIJ
UINI=UHIIJ
BWINI=BWIJ
UMINI=UFIJ
HINI=HIJ
BJINI=BJIJ
C2AVE(I+1)=TWAVE(I+1), DSTWAV(I+1)=,
SET UP FOR NEXT ITERATION
DX=X(I+2)-X(I+1)
BJAVE(I+1)=BJAVE(I+1)/NI
THAVE(I+1)=THAVE(I+1)/NI
HAVE(I+1)=HAVE(I+1)/NI
UWAVE(I+1)=UWAVE(I+1)/NI
UMAVE(I+1)=UMAVE(I+1)/NI
CLAVE(I+1)=CLAVE(I+1)/NI
BWAVE(I+1)=BWAVE(I+1)/NI
REAVE(I+1)=REAVE(I+1)/NI
D4AVE(I+1)=D4AVE(I+1)/NI
HWAVE(I+1)=HWAVE(I+1)/NI
HVAVE(I+1)=HVAVE(I+1)/NI
HVFAVE(I+1)=HVFAVE(I+1)/NI

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101

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37630000

D2SAVE(I+1)=D2SAVE(I+1)/NI
DLSTAV(I+1)=DLSTAV(I+1)/NI
D4AVE(I+1)=D4AVE(I+1)/NI
CFIP(I+1)=UMAVE(I+1)**2#0 .315/(UMAVE(I+1)*UE(I+1)*DLAVE(I+1)/12.
I/XNL)**C.1E2
IF(UCLAVE(I+1)-.95) 110,10CL,1001
110  CONTINUE
ICCI NI=JSAVE E
        DUM=(UMAVE(NI+1)-UMAVE(NI))/(X(NI+1)-X(NI))
        IF(JSAVE.GE.NPML) GO TO 531
        IF(UMAVE(NI+1)-1.CC5)531,531,532
C      GET XINI FGR C0NF8
        IC7E=1
        XINI=(1.OC5-UMAVE(NI))/DUM+X(NI)
        GC TC 1CC4
        XINI=(1.0-UMAVE(NI))/DUM+X(NI)
        DX=X(NI+1)-X(NI)
        DH=(THAVE(NI+1)-THAVE(NI))/DX
        TH5IN1=DTH*(XINI-X(NI))+THAVE(NI)
        DH=(THAVE(NI+1)-THAVE(NI))/DX
        HINI=DH*(XINI-X(NI))+HAVE(NI)
        1CC4 CONTINUE
        NE=JSAVE+1
        DC 520 I=NB,NE
        XCC=X(I1)/CREF/12.
        SCC=STEMP(I1)/CREF
        DMDSOC=CREF*DMDSD(I1)
        FCC=THAVE(I1)/CREF/12.
        DELSOC=DLSTAV(I1)/CREF/12.
        DCC=D4AVE(I1)/CREF/12.
520  WRITE(IW,2CC2) XCC,SCC,MTEMP(I1),DMDSOC,HAVE(I1),TOC,DELSOC,DOC
        2CC2 FCRNAT1H ,8F13.6)
        WRITE(IW,2003)
        2003 FCRNAT(/)
        DLTAIC,JS)=C4AVE(NE)/12.
        TTIA(IC,JS)=(2./((HAVE(NE)+I.-I./HAVE(NE))*CLAVE(NE))
        1+C.56*(I.-UWAVE(NE)/UMAVE(NE))*BJAVE(NE)
        2+C.42*(I.-UWAVE(NE)/UMAVE(NE))*2*BJAVE(NE)
        3+C.18*(I.-UWAVE(NE))*BWAVE(NE)
        4-C.742*(I.-UWAVE(NE))*2*BWAVE(NE)
        THIA(IC,JS)=THA(IC,JS)/12.
        RESTORE
        X(NI)=XNI

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3764C00C
3765C00C
3766C00C

UE{N} = UE1
RETUR
END

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SUBROUTINE CCNF8( IC, JS)
C GORADIOA'S COMPUTATION METHOD FOR THE CCNFLUENT BOUNDARY LAYER IN
C THE MAIN REGION 2
C
C CCNF8 WITH REDUCED EQUATIONS
COMMON NXLOTH(4,2),NXUPTH(4,2),C(4),XCT(165),ZCT(165),THETA(165),
      LS(165),XPCT(165),ZPC(165),NC,TITLE(8),ALFA,FSMCH,VGV(165),
      ZVT(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),TSTAG(4),SSTAG(4),
      ZLTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),P0,TO,RN,PR,KF,NCU,IPLIT,
      4CF(165),DLTAS(165),CREF,THCK(165),GVBT(165),VVB(165),
      SDLIASP(165),GVBD(165),VVBD(165),GVBDP(165),CN(4,10),
      GMAP,CK(5,3,2),XIS(3,2),XFST(3,2),FF(3,2)
      3767C0000
      3768C0000
      3769C0000
      3770C0000
      3771C0000
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      3802C0000
      3803C0000
      3804C0000
      3805C0000
      3806C0000
      3807C0000
      3808C0000

7. ISLET(3)
CCMNCN/TEMP/UWAVE(65),BJAVE(65),THAVE(65),HAVE(65),UNLAVE(65),
1BAVE(65),ELAVE(65),D2SAVE(65),REAVE(65),TWAVE(65),DSTAVE(65),
2D4AVE(65),HVAVE(65),HVAVE(65),UWAVE(65)
3.DLSIAY(65),CFIP(65)
CCMNCN/VISCOS/STEMP(65),MTEMP(65),DMJS(65),UE(65),DUEDS(65),
IDEMDS(65),X(65),ISURF,ITEMP(65),ZTEMP(65),XR(65)
CCMNCN/CNFLTR/ELTA(4,2),THTA(4,2)
CCMNCN/XINI/XINI,NF,NI,NI,XMINF,AO,UEG,XMG,DELI2,THETA2,XNU,PO,
ITINF,DELI,CELE,TEIR,BJI,BWI,FISQ,F2SQ,F2E,F1E,ThI,THE,XH,
2DELS,UINF,RO,XNU,RTCDTH,SKL
CCMNCN/CONST/S2M3,S2M4,S2M5,C5,C5INI,SM1,SM2,C23,C24,C25,C26,
IC11,C12,C13,C14,C15,C16,Al,G1,G2
DIMENSION C2AVE(65)
C CALCULATION OF CONDITION AT THE INITIAL STATION
M=6
      WRITE(M,2001)
2001 FORMAT(1X,14HMAIN REGION--II//)
      NB=N1
      N2=NB+1
      C2=1.73
      C22=-.00005
      DX=X(N1+1)-X(N1)
      DUW1 = ((UWAVE(N2)-UWAVE(N1))/(X(N2)-X(N1)))
      DUE = ((UE(N2)-UE(N1))/(X(N2)-X(N1)))
      UEINI= DUE*(XINI-X(N1)) +UE(N1)
      DTDX=(THAVE(N2)-THAVE(N1))/(X(N2)-X(N1))
      TH5INI= DTDX*(XINI-X(N1))+THAVE(N1)
      DTDX = 1HAVE(N2)-HAVE(N1)/(X(N2)-X(N1))
      HINI = DTDX*(XINI-X(N1)) + HAVE(N1)

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DUMDX=(UMAVE(N2)-UMAVE(N1))/(X(N2)-X(N1))
UMINI=DUMDX*(X(N1)-X(N2))+UMAVE(N1)
DEJ =(EJAVE(N2)-EJAVE(N1))/(X(N2)-X(N1))
BJINI=DBJ*(X(N1)-X(N2))+EJAVE(N1)
D2SINI = C21*TH5INI+C22
HVFINI = D2SINI/TH5INI
IF(HVFINI<1.8) 2C,21,21
HVINI=1.8
GC IC 22
IF(HVFINI<1.63)23,23,25
HVINI=1.63
GC TO 22
HVINI=HVFINI
21 CCNTINUE
22 FCINI =16.133-56.51/HVINI+54.54/HVINI**2
DISTR = TH5INI* HCINI
REINI = UMINI* UEINI * TH5INI / 12.0/ XNU
Y= ALOG(REINI)
XLT2= ALOG(2.518)-.918*HCINI +17.21*Y -0.743*Y**2-45.79*ALOG(Y)
TnMII5=EXP(XLT2)
XLT =ALOG(1.964E16)-1.819*HCINI +35.68*Y-1.365*Y*Y-
1.114.6*ALOG(Y)
CF2BUM = EXP(XLT)
XLT1 =ALOG(1.616E23)- .636*HCINI +48.55*Y-1.82 *Y*Y-158.7
1*ALOG(Y)
SHRINT = EXP(XLT1)
RTD5TW=(CF2BUM-TWMI5)/CF2BUM
SAVE
XN1= X(N1)
UE1= UE(N1)
C STORE N1 VALUES FOR X,UE. RESTORE AT END OF ROUTINE
X(N1)=XINI
UMIJ=UMINI+DUMDX*CX
DEJDX=C5INI*(UMINI-1.0)/(UMINI+1.0)*0.5+0.5*C5INI*(UMIJ-1.0) /
1(UUMIJ+1.)
UE(N1)=UEINI
B2IJ=B2INI+DBJDX*DX
T+IJ = TH5INI+DTHDX*DX
HIJ = HINI+DHDX*DX
CF2BUM=CF2BUM*.5
TWMI5=TWMI5*C.49
SHRINI=SHRINT*0.65
DUW1UX=DUW1

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DLMDX=DLMDX
NFM1=NFM1
DC 110 I=N1,NFM1
DUMDX=(DUM+DUMDX)/2.
DUW1=(CUW1+DUW1DX)/2.
JSAVE=I
UNAVE(I+1)=0.
BJAVE(I+1)=0.
THAVE(I+1)=0.
HAVE(I+1)=C.
UHAVE(I+1)=0.
BHAVE(I+1)=0.
REAVE(I+1)=0.
HAVE(I+1)=0.
HFAVE(I+1)=0.
D2AVE(I+1)=0.
DLSTAV(I+1)=0.
E2AVE(I+1)=0.
D1AVE(I+1)=0.

C JET LAYER CALCULATIONS
UEMEAN = UE(I+1)*.5 + UE(I)*.5
DUEDX=(UE(I+1)-UE(I))/(X(I+1)-X(I))
DX=X(I+1)-X(I)
DC 101 J=1,N1
UMEAN=UMINI*.5+ UMIJ*.5
BJMEAN=BGINI*.5+ EJIJ*.5
HMEAN =HINI*.5+ HIJ*.5
IF MEAN=THSINI*.5+ THIJ*.5
UMI=UMEAN-1.
UM1=UMEAN*UMI
UE2=2.0/UEMEAN*DUEDX
T1UMBJ=S2M4*UM1*DBJDX+(S2M3-S2M5)*UM1**2*DBJDX
TIPRES=S2M4*UM1*BJMEAN*UE2+(S2M3-S2M5)*UM1**2*BJMEAN*UE2-S2M4*
UM1*EJMEAN/UEMEAN*DULEDX
TIPRS1=-UE2*UM1*TMMEAN*HMEAN/(HMEAN-1.)*2*(1.0/UMMEAN)*(1.0*)
IHMEAN**2-5.0*HMEAN-1.0)+UMMEAN*(HMEAN+1.)
TIPRES=TIPRES+TIPRS1
TISKF=4.*UM1*CF2BLM*HMEAN**2/(HMEAN-1.)*2+UM1*CF2BUM*RTD5TW*
1(5.0*HMEAN-1.0)/(HMEAN-1.0)-2CF2BLM*UMMEAN**2*RTD5TW
TISHWK=-UM1*(3.*HMEAN-1.)*2*(HMEAN-1.)*2*SHRINT
TIDENO = S2M4*UMMEAN*BJMEAN + (S2M4-2.*S2M3+ 2.*S2M5)*(UMMEAN-1.)
1*BJMEAN + 2.*UMMEAN*(HMEAN-1.)*THMEAN *(HMEAN+1.)*2

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DUMDX = (T1UMBJ + TIPRES + T1SKF + T1SHWK) / T1DENG
DLMDX=DUM(DUMDX)
DLMDX=(DUM+DJMDX)/2*
UWIJ = UMINI + DUMDX*DX
C ejdx=CS*(UMIN1-1.0)/(UMINI+1.0)*.5+C5*.5*(UMIJ-1.0)/(UMIJ+1.0)
B1IJ = B1INI+DEBJDX*DX
UMEAN=UMINI*.5+UMIJ*.5
B1MEAN=B1INI*.5+B1IJ*.5
WALL LAYER MOMENTUM INTEGRAL EQUATION
T3THLM=2.*THMEAN/(HMEAN-1.0)*DUMUX/UMEAN
T3PRES = 2.*THMEAN/(HMEAN-1.0)*DUEDX/UEMEAN -(1./UMEAN**2)/
UEMEAN*DUEDX*(HMEAN+1.0)/(HMEAN-1.0)*THMEAN
T3SKF = TWITS
DTDX = (T3THUM + T3PRES + T3SKF)
THIJ = TH5INI+DTDX*DX
THMEAN=TH5INI*.5+THIJ*.5
HMEAN=HVINI*.5+HVIJ*.5
WALL LAYER ENERGY INTEGRAL EGUN.
T4HVLM=-3.*THMEAN*HMEAN/UMEAN*DUMDX+2.0*THMEAN*HMEAN/(2.-HMEAN)
1)*DUMDX/UMEAN
T4PRES = -3.*THMEAN*HMEAN/UEMEAN*DUEDX +2.*THMEAN*HMEAN/(2.-HMEAN) /
1((2.-HMEAN)/UEMEAN*DUEDX - 2.0*THMEAN*HMEAN/(2.-HMEAN))
2*UMEAN**2 / UEMEAN * DUEDX
T4SHFK = 2.0 * SFINT
T4SKF = -2.0 * RIC5IW * CF2BUM
DD2SDX=(T4HVUM + T4PRES + T4SHWK + T4SKF)
D2SIJ = D2SINI + CC2SDX*DX
HVFOI = D2SIJ / THIJ
IF(HVFOI-1.8)300,301,301
301 HVIJ=1.8
302 GC TO 302
CCNTINE
300 IF(HVFOI-1.63)303,303,305
303 HVIJ=1.63
304 GC TO 302
305 HVIJ=HVFOI
302 CCNTINE
HIJ=16.133-56.91/HVIJ+54.54/HVIJ**2
RET-1J=UMIJ*UE(I+1)*(THIJ/12.0)/XNU
Y=ALCG(REINI*0.5+RETHIJ*0.5)
HMEAN=HINI*.5+HVIJ*.5
XLIT=ALCG(1.564E16)-1.819*HMEAN+35.68*Y-
11.365*Y-114.6*ALCG(Y)
CF2BUM=EXP(XLT)

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XL12=ALCG(2.518)-.518*HMEAN+17.21*Y-.743*Y**2
XL12=XL12-.45.75*ALCG(Y)
TMM15=EXP(XL12)
XL11=ALCG(1.616E23)-.036*HMEAN+.48.55*Y-
1.1-.82*Y*Y-.158.7*ALCG(Y)
SHRINT=EXP(XL11)
RID5IW=(CF2BUM-TMW15)/CF2BUM
DINAL=.C0596+.12.88*THIJ+.97*THIJ**2
DSTRWL= THIJ*HIJ
DSTRJT= BJIJ*(1.-UMIJ)+BJIJ*(UMIJ-1.0)*S2M3
CF2BLN=CF2EUM*.5
SHRINT=SHRINT*.65
TMW15=TMW15*0.45
UMAVE(I+1)=UMAVE(I+1)+UMIJ
BJAVE(I+1)=BJAVE(I+1)+BJIJ
THAVE(I+1)=THAVE(I+1)+THIJ
HAVE(I+1)=HAVE(I+1)+HIJ
REAVE(I+1)=REAVE(I+1)+RETHIJ
HVAVE(I+1)=HVAVE(I+1)+HVIJ
HVFAVE(I+1)=HVFAVE(I+1)+HVFOI
D2SAVE(I+1)=D2SAVE(I+1)+D2SIJ
DLSTAV(I+1)=DLSTAV(I+1)+DSTRWL+DSTRJT
D2=D1WAL+BJIJ
D2AVE(I+1)=D2AVE(I+1)+D2
CLAVE(I+1)=CLAVE(I+1)+D1WAL
CFIP(I+1)=LMAVE(I+1)**2*0.315/(UMAVE(I+1)*UE(I+1)*D1AVE(I+1))
1/12./XNU)*0.182
CONTINUE
REINI=RETHIJ
THSINI=THIJ
HVINI=HVIJ
D2SINI=D2SIJ
UMINI=UMIJ
HINI=HIJ
BJINI=BJIJ
DHDX=(HIJ-HINI)/CX
DX=X(I+2)-X(I+1)
UMIJ=UMIJ+DUMUX*CX
THIJ=THIJ+DTHDX*CX
HIJ=HIJ+DHDX*DХ
BJIJ=BJIJ+DBJDX*CX
BJAVE(I+1)=BJAVE(I+1)/NI
THAVE(I+1)=THAVE(I+1)/NI

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HAVE(I+1) = HAVE(I+1)/NI
UHAVE(I+1)=UHAVE(I+1)/NI
UHAVE(I+1)=UMAVE(I+1)/NI
BHAVE(I+1)=BHAVE(I+1)/NI
REAVE(I+1)=REAVE(I+1)/NI
HAVE(I+1)=HAVE(I+1)/NI
HAVE(I+1)=HAVE(I+1)/NI
HAVE(I+1)=HAVE(I+1)/NI
D2SAVE(I+1)=D2SAVE(I+1)/NI
DLSTAV(I+1)=DLSTAV(I+1)/NI
CLAVE(I+1)=CLAVE(I+1)/NI
CLAVE(I+1)=CLAVE(I+1)/NI
IF(UMAVE(I+1)-1.0C5)1G01,110,110
110
CONTINUE
1CC1 NE=JSAVE+1
DC 520 I=NB,NE
XCC=X(I)/CREF/12.
SGC=STEMP(I)/CREF
DNDSC=CREF*DMS(I)
TCC=IHAVE(I)/CREF/12.
DELSCC=DLSTAV(I)/CREF/12.
DGC=C2AVE(I)/CREF/12.
WRITE(M,20C2) XCC, SCC, MTEMP(I), DMDSOC, HAVE(I), TQC, DELSOC, DOC
20C2 FORMAT(IH ,8FL3.6)
WRITE(M,20C3)
2CC3 FORMAT(/)
DLTAC,JS)=D2AVE(NE)/12.
IHTAC,JS)=(2.*(HAVE(NE)+1. )-1. )/HAVE(NE)*CLAVE(NE)
1+C.56*(1.-1./UMAVE(NE))*BJAVE(NE)+0.42*(1.-1./UMAVE(NE))**2
2*EJAVE(NE)
THTAC,JS)=THTA(IC,JS)/12.
C
RESTIRE
X(N1)=XN1
UE(N1) = UE1
N1=JSAVE
RETURN
END

```

```
FUNCTION DLIM(ARG)
DLIM=ARG
DSG= SIGN(1.0,ARG)
IF ABS(ARG)-0.2) 10,10,2C
DLIM=0.2*DSG
RETURN
END
```

20
10

```

SUBROUTINE LOAD(NP,IC)
CNP,CNF,CAP,CAF,CMP,CMF)
REAL MTEMP
CCMMCN NXLCTH(4,2),NXUPTH(4,2),CH(4),XCT(165),ZCT(165),THETA(165),
1S(165),XPC(165),ZFC(165),NC,TITLE(8),ALFA,AMEIF,ML(165),
2VI(165),CP(165),GV(165),XSTAG(4),ZSTAG(4),TSTAG(4),SSTAG(4),
3LTRAN(4,2),XTRAN(4,2),ZTRAN(4,2),PO,TO,RN,PR,KF,NCU,IPLOT,
4CFI(165),DLTAS(165),CREF,THICK(165),GVBT(165),VVB(165),
5DLTASP(165),GVBD(165),VVB(165),GVBDP(165),CNN(4,10),
6MAP,CK(5,3,2),XIS(2,2),XFS(3,2),FFS(3,2)
7,ISLCT(3)
402400000
402500000
402600000
402700000
402800000
402900000
403000000
403100000
403200000
403300000
403400000
403500000
403600000
403700000
403800000
403900000
404000000
404100000
404200000
404300000
404400000
404500000
404600000
404700000
404800000
404900000
405000000
405100000
405200000
405300000
405400000
405500000
405600000
405700000
405800000
405900000
406000000
406100000
406200000
406300000
406400000
406500000
CNP=CNF
N1P=N1+1
DC 3C I=N1P,N2
CAP=CAP+(CP(I)+CP(I-1))/2.* (THCK(I)-THCK(I-1))/CREF

```

10

20

C

```
30    CONTINUE
      CAP=-CAP
      CAF=C.
      DC 40  I=2,NX
      IL=NXL+1-1
      IL=NXL-1+1
      F2=(CF1(IL)+CF1(IL))/CREF
      F1=(CF1(IL+1)+CF1(IL-1))/CREF
      CAF=(CAF+(F2+F1)/4.*CH(IC)*(COS(THETA(IL))-CCS(THETA(IL+1)))
      CONTINUE
      RETURN
END
```

```

C SUBROUTINE TRANS (XTRANS,ZTRANS,XMS,ZMS,X,Z,DELTA,XP,ZP,NPT)
C
C * ROTLINE TO ROTATE AND TRANSLATE COORDINATE SYSTEM
C
C * CALLING SEQUENCE . . . .
C * CALL TRANS (XTRANS,ZTRANS,XMS,ZMS,X,Z,DELTA,XP,ZP,NPT)
C * XTRANS AND ZTRANS ARE THE TRANSFORMED COORDINATE ARRAYS,
C * XMS AND ZMS DEFINE THE ORIGIN IN THE TRANSFORMED SYSTEM,
C * X AND Z ARE THE ORIGINAL COORDINATE ARRAYS,
C * XF AND ZP DEFINE THE CRIGIN IN THE ORIGINAL SYSTEM,
C * DELTA IS THE ROTATION ANGLE IN RADIANS, NPT IS THE NUMBER
C * OF ELEMENTS IN THE COORDINATE ARRAYS
C
C * DIMENSION XTRANS(1),ZTRANS(1),X(1),Z(1) . . . . . .
C CGSD=COS(DELTA)
C SIND=SIN(DELTA)
DC 10 I=1,NPT
XSAVE=X(I)
XTRANS(I)=XMS+(X(I)-XP)*CGSD+(Z(I)-ZP)*SIND
ZTRANS(I)=ZMS+(Z(I)-ZP)*CGSD-(XSAVE-XP)*SIND
10 CONTINUE
RETURN
END

```

```

SUBROUTINE LSQ (FX,X,N,NP,C)
C
C   LEAST SQUARES CURVE FIT ROUTINE
C
C   CALLING SEQUENCE.....
C   CALL LSC (FX,X,N,NP,C)
C   FX IS THE DEPENDENT VARIABLE, X IS THE INDEPENDENT VARIABLE,
C   NUMBER OF OBSERVATIONS, AND C IS THE COEFFICIENT VECTOR.
C
C   F(X)=C(1)+C(2)*X+C(3)*X**2+...+C(N+1)*X**N
C
C   DIMENSION A(11,12),C(11),X(11),FX(11)
C   DOUBLE PRECISION A,T1,T2
C   N1=N+1
C   N2=N+2
C
C   SET UP MINIMIZING MATRIX
C
DC 1C I=1,N1
DC 10 J=1,N2
10 A(I,J)=C.
DC 30 K=1, NP
T1=1.
DC 30 J=1,N1
T2=T1
DC 20 I=1,N1
A(J,I)=A(J,I)+T2
20 T2=T2*X(K)
A(J,N2)=A(J,N2)-FX(K)*T1
T1=T1*X(K)
3C
C   SOLVE FOR COEFFICIENT VECTOR
C
DC 40 K=1,N
DC 40 J=K,N
T1=A(J+1,K)/A(K,K)
DC 40 I=K,N2
DC 40 A(J+1,I)=A(J+1,I)-A(K,I)*T1
4C A(N1)=A(N1,N2)/A(N1,N1)
C(N1)=-A(N1,N2)/A(N1,N1)
DC 5C I=2,N1
410300000
413400000
410500000
410600000
410700000
410800000
410900000
411000000
411100000
411200000
411300000
411400000
411500000
411600000
411700000
411800000
411900000
412000000
412100000
412200000
412300000
412400000
412500000
412600000
412700000
412800000
412900000
413000000
413100000
413200000
413300000
413400000
413500000
413600000
413700000
413800000
413900000
414000000
414100000
414200000
414300000
414400000

```

```
K=N2-I  
C(K)=-A(K,N2)/A(K,K)  
L=K+1  
DC 50 J=L,N1  
5C C(K)=C(K)-C(J)*A(K,J)/A(K,K)  
RETURN  
END
```

```

SUBROUTINE PR001 (A,X)
C   . . . . .
C   . . . . . ROUTINE TO FIND THE ROOTS OF A CUBIC POLYNOMIAL
C   . . . . .
C   . . . . . CALLING SEQUENCE......
C   . . . . . CALL PR001 (A,X)
C   . . . . . A IS THE COEFFICIENT VECTOR, X IS THE SOLUTION VECTOR
C   . . . . . A(1)+A(2)*X+A(3)*X**2+A(4)*X**3=0
C   . . . . .
C   . . . . *NOTE THIS ROUTINE USES THE CUBIC FORMULA
C   . . . . .
C   . . . . **NOTE X IS COMPLEX, X=X(1)+I*X(2), ETC.
C   . . . . .
C   . . . . DIMENSION A(4),Z(6),X(6)
C   . . . . DIMENSION L(6),V(6)
C   . . . . REAL IM
C   . . . . PI=3.1415927
C   . . . . .
C   . . . . DETERMINE THE COEFFICIENTS OF THE TRANSFORMED CUBIC
C   . . . . FCLYNCMIAL
C   . . . . .
C   . . . . H=(3.*A(4)*A(2)-A(3)**2)/(9.*A(4)**2)
C   . . . . G=(2.*A(3)**3-9.*A(4)*A(3)*A(2)+27.*A(4)**2*A(1))/(27.*A(4)**3)
C   . . . . .
C   . . . . COMPUTE THE DISCRIMINANT
C   . . . . .
C   . . . . TESI=G**2+4.*H***3
C   . . . . IF (TEST) 10,30,30
C   . . . . 1C IM=SQRT(ABS(TEST))/2.
C   . . . . RE=-G/2.
C   . . . . R=SQRT(RE**2+IM**2)
C   . . . . THETA=ATAN(IM/RE)
C   . . . . IF (THETA) 20,60,6C
C   . . . . 2C THETA=THETA+PI
C   . . . . GC 10 6C
C   . . . . 3C R=(-G+SQRT(TEST))/2.
C   . . . . IF (R) 40,50,5C
C   . . . . 40 THETA=PI
C   . . . . R=-R
C   . . . . GC TC 60

```

```

C      5C THETA=C.
C      C COMPUTE THE CUBE ROOTS OF U AND V
C
C      6C R13=R*(1./3.)
DC    7C K=1,6,2
T=PI/3.+(K-1)*PI/3.
CT=CCS(T)
ST=SIN(T)
U(K)=R13*CT
U(K+1)=R13*ST
V1=-F/(U(K)**2+U(K+1)**2)
V(K)=V1*U(K)
7C V(K+1)=-V1*U(K+1)

C      C TRANSFORM THE ROOTS BACK TO THE ORIGINAL COORDINATE SYSTEM
C
C      DG 8C K=1,6
8C Z(K)=U(K)+V(K)
R=A(2)/(3.*A(4))
DC S0 I=1,6,2
X(I+1)=Z(I+1)
9C X(I)=Z(I)-R
-RETUN
END

```

```

SUBROUTINE POINT (X,Y,XINT,YINT,NN1,NN2,A)
C
C
C   PARABOLIC INTERPOLATION ROUTINE
C
C   CALLING SEQUENCE. . . .
C   CALL POINT (X,Y,XINT,YINT,NN1,NN2,A)
C
C   X IS THE INDEPENDENT VARIABLE, Y IS THE DEPENDENT VARIABLE,
C   XINT IS THE INTERPOLANT, YINT IS THE INTERPOLATED VALUE,
C   NN1 IS THE INDEX OF THE FIRST ELEMENT IN THE SEARCH,
C   NN2 IS THE INDEX OF THE LAST ELEMENT IN THE SEARCH,
C   A(1)-A(3) ARE THE PARABOLIC COEFFICIENTS.
C
C   YINT= A(1)+A(2)*XINT+A(3)*XINT**2
C
C   A(4) IS THE INDEX OF THE ELEMENT IN THE X ARRAY WHICH IS
C   NEAREST TO XINT
C
C   *NOTE THE X ARRAY MUST BE MONOTONIC INCREASING
C
C   DOUBLE PRECISION A2,A3,A
C   DIMENSION X(1),Y(1),A(4)
C   DIMENSION XP(3),YP(3)
C
C   FIND THE NEAREST ELEMENT
C
DG 10 I=NN1,NN2
  KK=I
  IF (XINT-X(I)) 20,40,10
10  CONTINUE
20  XX=X(KK-1)+(X(KK)-X(KK-1))/2.
  IF (YINT-XX) 30,40,40
30  KK=KK-1
  IF (KK.LT.NN1) KK=NN1
4C  A(4)=KK
  N2=KK-1
  IF (N2-NN1) 50,50,6C
50  N2=NN1
  GC  IC 80
6C  IF (NN2-(N2+2)) 70,80,80

```

```

7C N2=NN2-2
8C CENTINUE
C POSITION THE ORIGIN ON THE NEAREST ELEMENT
C
C XFB=XINT-X(N2+1)
D9 SC K=1,3
L=N2+K-1
XP(K)=X(L)-X(N2+1)
YR YP(K)=Y(L)-Y(N2+1)
C SOLVE FOR PARABOLIC COEFFICIENTS
C
A2=(YP(1)*XP(3)/XP(1)-YP(3)*XP(1)/XP(3))/(XP(3)-XP(1))
A3=(YP(1)/XP(1)-YP(3)/XP(3))/(XP(1)-XP(3))
YIN=Y(N2+1)+A2*XPB+A3*XPB*XPB
C RETURN TO ORIGINAL COORDINATE SYSTEM
C
A(1)=Y(N2+1)-A2*X(N2+1)+A3*X(N2+1)*X(N2+1)
A(2)=A2-2.*A3*X(N2+1)
A(3)=A3
RETURN
END

```

```

SUBROUTINE SLOPE (X,A,YPRIME)
C   . . . . .
C   . PARABOLIC DIFFERENTIATION ROUTINE
C   . .
C   . CALLING SEQUENCE . . .
C   . CALL SLCPE (X,A,YPRIME)
C   . X IS THE INDEPENDENT VARIABLE, A IS THE COEFFICIENT VECTOR
C   . FRM POINT, YPRIME IS THE DERIVATIVE AT X
C   . .
C   . .
C   . DOUBLE PRECISION A
C   . DIMENSION A(4)
C   . YPRIME=A(2)+2.*A(3)*X
C   . RETURN
C   . END
        428500000U
        428600000
        428700J00
        428800000
        428900000
        429000000
        429100000
        429200000
        429300000
        429400UCJ
        429500000
        429600000
        429700000
        429800000
        429900000
        430000000

```

```

SUBROUTINE INTEG (XA,XB,N1,N2,X,FX,S,IERR)
C
C
C     PARABOLIC INTEGRATION ROUTINE
C
C     CALLING SEQUENCE.....
C
C     CALL INTEG (XA,XB,N1,N2,X,FX,S,IERR)
C
C     X IS THE INDEPENDENT VARIABLE, FX IS THE INTEGRAND,
C     XA IS THE LOWER LIMIT, XB IS THE UPPER LIMIT,
C     N1 IS THE INDEX OF THE FIRST ELEMENT IN THE X ARRAY,
C     N2 IS THE INDEX OF THE LAST ELEMENT IN THE X ARRAY,
C     S IS THE INTEGRAL FROM XA TO XB, IERR IS AN ERROR FLAG
C
C     DOUBLE PRECISION A
C     DIMENSION X(1),FX(1),S(1),A(4)
IERR=0
IT=7
XL=XA
S(N1)=0.0
C
C     ARE THERE AT LEAST THREE POINTS IN THE X ARRAY, IF NOT USE A
C     LINEAR INTEGRATION
C
IF (N2-N1-2) 10,20,20
1C S(N2)=FX(N1)*(XB-XA)+(FX(N2)-FX(N1))/((X(N2)-X(N1))/2.*((XB-XA)*(XB-
XA-2.*X(N1)))
REIL&N
20 CCNTINUE
NFTS=N2-N1+2
IF (NFTS.GE.3) GC TC 30
IERR=1
WRITE (IT,110)
RETURN
C
C     SOLVE FOR THE COEFFICIENT VECTOR
C
30 DC SC I=N1,N2
DS=C.0
CALL PCINT (X,FX,XL,FXL,N1,N2,A)
J=A(4)

```

```

C      SET THE UPPER LIMIT FOR THIS INTEGRATION STEP
C
C      IF ((J+1) .GT. N2) GO TO 50
C      XX=(X(J+1)-XA)/(XE-XA)
C      IF (XX-1.0) 40,40,50
C      4C   XU=X(J+1)
C      FXL=FX(J+1)
C      GC  TC 60
C      5C   XL=XB
C
C      TBC, FOUR, SIX, EIGHT NOW ITS TIME TO INTEGRATE
C
C      EC  DC 7C K=1,2
C      70  DS=DS+A(K)/K*(XU**K-XL**K)
C          S(I+1)=S(I)+DS
C          SN2=S(I+1)
C          IF (XU-XB) 80,1C0,8C
C          EC  XL=XU
C          9C  CONTINUE
C          1C0 SIN2)=SN2
C          RETURN
C
C      110 FGRMAT (44HOSUBROUTINE POINT CALLED IN SUBROUTINE INTEG)
C      END

```

434300000
434400000
434500000
434600000
434700000
434800000
434900000
435000000
435100000
435200000
435300000
435400000
435500000
435600000
435700000
435800000
435900000
436000000
436100000
436200000
436300000
436400000
436500000
436600000

```

SUBROUTINE GJRV (A,N,NL,EPSSIL,IERR)
C
C
C      MATRIX INVERSION ROUTINE
C
C      CALLING SEQUENCE:
C      CALL GJRV (A,N,NL,EPSSIL,IERR)
C      A IS THE INPUT ARRAY WHICH WILL BE DESTROYED, N IS THE RANK
C      OF A, NL IS THE FCW DIMENSION OF A, EPSSIL IS THE TEST
C      VALUE FOR THE PIVOT POINT SINGULARITY CHECK,
C      IERR IS NONZERO IF THE MATRIX IS SINGULAR
C      IF THE MATRIX IS NONSINGULAR, A COUNTAINS A-INVSE
C
C      DIMENSION A(1),B(180),C(180),IP(180),IQ(180)
IERR=0
DC 160 K=1,N
PIVCT=0.
C
C      GET LARGEST ELEMENT IN MATRIX PLACE IN PIVCT
C
DC 30 I=K+N
DC 20 J=K+N
INDEX=(J-1)*NL+I
IF (ABS(A(IINDEX))-ABS(PIVOT))>20,20,10
10 CCNTINUE
PIVCT=A(IINDEX)
IF (K)=I
IC(K)=J
20 CCNTINUE
30 CCNTINUE
IF (ABS(PIVOT)-EPSSIL)>230,230,40
40 CCNTINUE
IF (IP(IK)-K)>50,70,50
50 CCNTINUE
C
C      SWAP ROWS
C
DC 6C J=1,N
IPX=IP(K)
INDEX=(J-1)*NL+IPX
KCX=(J-1)*NL+K
436700000
436800000
436900000
437000000
437100000
437200000
437300000
437400000
437500000
437600000
437700000
437800000
437900000
438000000
438100000
438200000
438300000
438400000
438500000
438600000
438700000
438800000
438900000
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439200000
439300000
439400000
439500000
439600000
439700000
439800000
439900000
440000000
440100000
440200000
440300000
440400000
440500000
440600000
440700000
440800000

```

```

Z=A(ICEX)
A(ICEX)=A(KDEX)
A(KDEX)=Z
6C CCNTINUE
7C CCNTINUE
IF (IQ(K)-K) 8C,1CC,80
8C CCNTINUE

C      SHAP COLUMNS
C
DC 9C I=1,N
IFX=IC(K)
IDEX=(IPX-1)*NL+I
KDEX=(K-1)*NL+I
Z=A(IDEK)
A(ICEX)=A(KDEX)
A(KDEX)=Z
9C CCNTINUE
10C CCNTINUE
DC 140 J=1,N
KDEX=(J-1)*NL+K
JDEX=(K-1)*NL+J
IF (J-K) 120,110,120
11C CCNTINUE
B(J)=1./PIVGT
C(J)=1.
GC 7C 130
12C CCNTINUE
B(J)=-A(JDEX)/PIVOT
C(J)=A(JDEX)
130 CCNTINUE
A(KDEX)=0.
A(JDEX)=0.
14C CCNTINUE
DC 150 I=1,N
DO 150 J=1,N
IDEX=(J-1)*NL+I
A(ICEX)=A(ICEX)+C(I)*B(J)
150 CCNTINUE
16C CCNTINUE
DC 220 KP=1,N
K=N+1-KP
IF (IF(K)-K) 17C,19C,170

```

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